MAR 26 1925

PUBLIC WORKS

COUNTY STATE

Tarvia Service *Chapter III*

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THE dependable precision of Tarvia delivery service is often commented on. Yet it is a fact that but few Tarvia enthusiasts realize the volume and character of the equipment that makes this service possible.

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A fleet of motor truck distributors each equipped with the famous Barrett nozzle.

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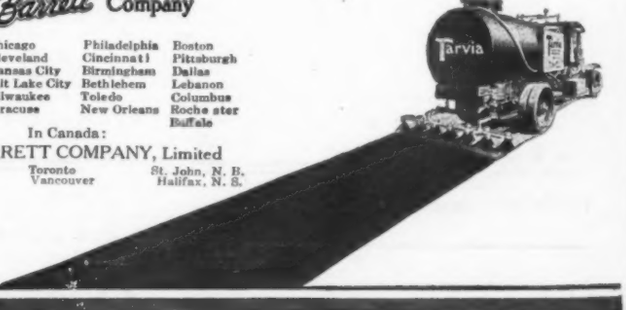
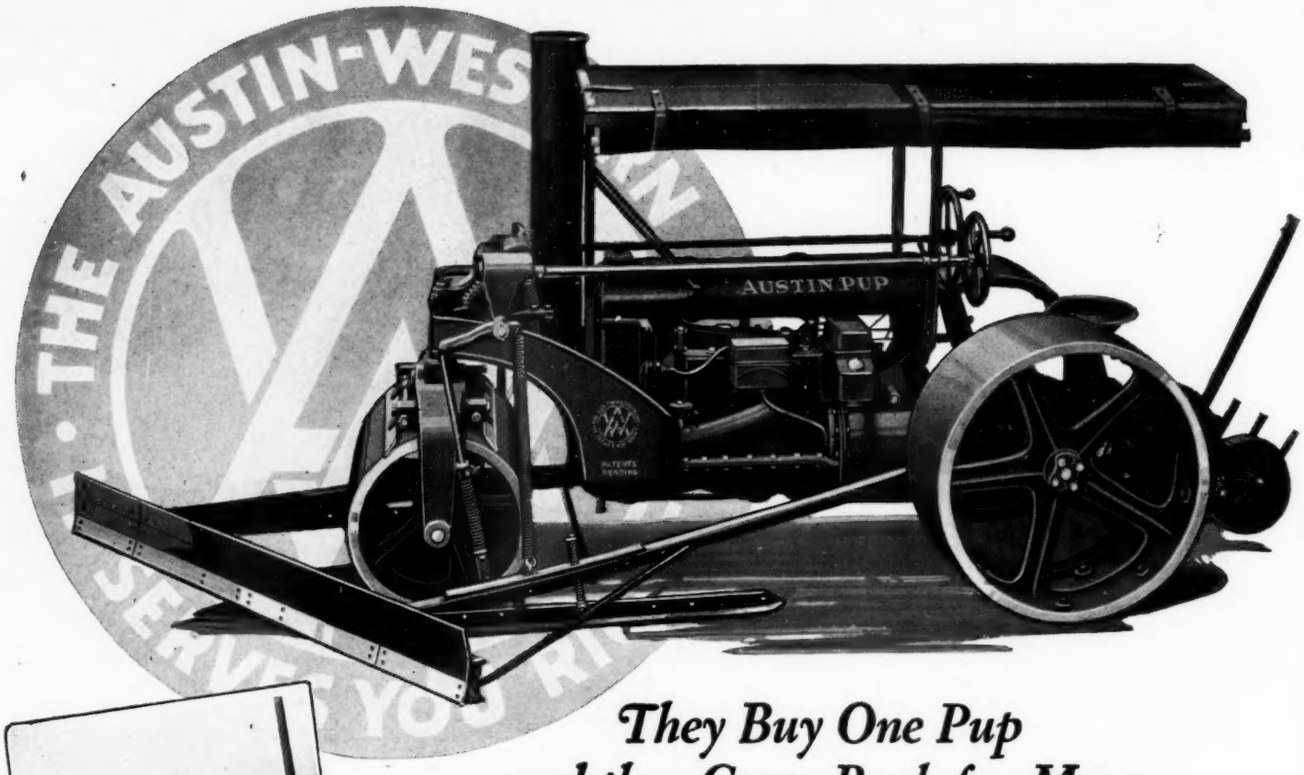
Tarvia

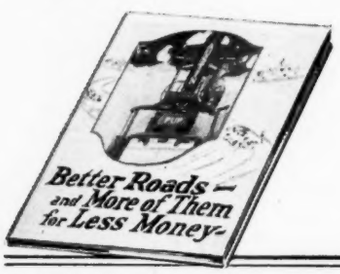
For Road Construction Repair and Maintenance



MARCH, 1925



The coupon will bring you the whole story of the Austin Pup. You'll find it interesting.



They Buy One Pup and then Come Back for More

UNTIL the Austin Pup was exhibited at the 1923 Good Roads Show, no one supposed that a single, one-man machine, costing little to buy and next to nothing to run, could combine the features of a road maintainer, roller and scarifier, and replace elaborate outfits costing several times as much both to buy and operate. In a word, the Pup seemed almost too good to be true, so while some officials and contractors were quick to realize its possibilities, they generally ordered but a single machine at first to make sure it was really as good as it looked.

They bought one Pup and then came back for more, and there is no better evidence of satisfactory performance than repeat orders. Space will not permit anything like a complete list of all the fleets of Pups that are now engaged in saving time, labor and money for their owners, but here is a list of 100 "Repeats" that is typical of all the rest.

Florida State Highway Department			5	New York State Highway Department			8
Georgia	"	"	5	N. Carolina	"	"	10
Indiana	"	"	2	Ohio	"	"	2
Michigan	"	"	11	Virginia	"	"	6
Missouri			2				

University of Iowa		2	Joseph Kesl & Sons	Ill.	2	J. C. Devine Co.	Ohio 2
Berrien County	Mich.	3	The Madison Const. Co.	"	2	Connell Laub &	
Town of Northcastle	N.Y.	4	Verhey Construction Co.	"	2	Bracht Const. Co.	" 2
Oswego County	"	2	George T. Miller	Ind.	2	Green Construction Co.	Okla. 2
Caddo County	Okla.	2	Harrison Const. Co.	Iowa	2	David Schoentag, Inc.	Penn. 2
Hamilton County	Tenn.	3	Ritchie & Ramsey	Kans.	2	W. L. Pearson & Co.	Tex. 3
Bryson Paving Co.	Fla.	2	Louis Des Cognets Co.	Ky.	2	Smith Brothers Inc.	" 3
Cecil R. Scott	"	2	Devendorf Corporation	N.Y.	4	Uvalde Rock Asphalt Co.	" 2
Milburn Bros.	Ill.	2	McDonald Const. Co.	"	2	Hoffman Construction Co.	" 2

Pup imitators are making desperate efforts to construct a machine that will do the work of the Pup, by attaching a blade to a roller, without the long runners or the depth gauges or the springs that are covered by our patents. One concern has made as many as three different types, all of them failures. These elements of runners, depth gauges and springs are an essential feature of this machine, and no machine can be made to do its work without them. The value of the Pup lies, to a great extent, in its blade equipment, as nothing can equal it in maintaining, grading and leveling at a minimum expense. The work of the blade is made possible by the long runners that hold it to a level course through hills and hollows, while blades without these runners ride over the hills and deepen the hollows. This explains why nearly all Pups are sold with full blade equipment and why some competitors are trying to sell rollers alone, concerning which there is nothing new, because of being unable to attach any blade equipment without infringing our patents. The blade is the most important part of this machine, and even though you don't need it now, you probably will on the next job, so don't buy a Pup without its blade.

I'd like to know more about the Austin Pup.

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THE AUSTIN-WESTERN ROAD MACHINERY CO.
CHICAGO

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MARCH, 1925

PUBLIC WORKS

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 56 MARCH, 1925 No. 3

Massive Foundations in Soft Ground

Unusual features of design and construction of foundations for a large steam electric power plant in New York City, involving difficult excavation, pile driving by special methods and unusually heavy mass concrete.

The New York Edison Company is building at the foot of East 14th street, Borough of Manhattan, New York City, one of the largest steam electric generating stations ever constructed. It will eventually occupy most of the area of two city blocks, between 14th and 15th Streets, the East River and Avenue C. The adjacent block between 13th and 14th Streets, the river and Avenue D was available for receiving, unloading, storing and handling construction plant, materials and supplies, thus making it possible to maintain the building site free of obstructions during construction. The waterfront of the power-plant property will be dredged to permit access to the dock of heavily laden coal and other barges. The adjacent river will also furnish an unlimited supply of condensation water, of which large quantities will be used.

The buildings now under way include engine house, boiler house and galleries covering most of the area of 206x374 feet east of Avenue D and about one-third of the area west of the Avenue, which is 206x676. The work is being done for the New York Edison Company, E. M. VanNorden, engineer, by the Ken-Well Contracting Company, Frank E. Cudworth, superintendent, at a cost exceeding $25,000,000.

The foundation is required to support not only a building extending about 130 feet above curb level, but nine 62,500-kw. steam turbine generators. To effect this the entire area is covered with wooden foundation piles spaced 28 to 30 inches apart, about 18,000 being required. These support a continuous mass of concrete 15 feet thick. For utilizing the river water for condensation, 400 feet of 11x20 ft. concrete and discharge tunnels are being built; also a screen chamber and nearly a mile of 6-foot cast iron suction and discharge pipes.

TWO-BOOM TRAVELER EQUIPPED WITH HOISTING ENGINES, DOUBLE-ACTING STEAM HAMMERS, AND SUSPENDED LEADS FOR DRIVING 1,100 PILES FROM ONE POSITION.

In order to facilitate speed of execution, the work was planned so that excavation for the substructure, driving the piles and mixing and dis-

tribution of the concrete could all be carried on simultaneously once a part of the excavation had reached its full depth.

EXCAVATION

The surface of the ground was approximately level and only a few feet above high-tide, the soil consisting chiefly of fill containing old foundations, boulders and timbers overlying a stratum of coarse sand and clay. The soil was saturated nearly up to the surface and had very little bearing value, so that ordinary steam-shovel excavation would be impossible except for the few feet nearest the surface. Bucket excavation, however, would be much more expensive.

The difficulty was met by a very thorough and efficient system of drainage which lowered the water table in advance of the excavation and enabled steam shovels to be used for all excavation except the trenches for the concrete condensation water tunnels. At first the ground was drained by surface ditches leading to numerous sumps that were emptied by portable gasoline pumps. When the excavation had reached about 7 feet below the curb the ground became so wet and soft that the ditches were supplemented by deep trenches leading to a special sheeted sump about 37 feet deep, broken stone being filled in at the bottom and around the sides to insure free flow of ground water. This sump was kept lowered by two 8-inch Kingsford centrifugal pumps driven by two 20-horsepower electric motors, one pump usually being in reserve. There was considerable seepage from the river, but this was materially checked by three parallel lines of steel sheet piles driven across the lot near the river-front.

Steam shovel excavation commenced in June, 1924, a depth of about 16 feet being reached on each side of Avenue D, about 30,000 yards above high-tide level and 50,000 yards below it being removed. The shovels delivered directly to a fleet of 5-yard Mack motor trucks running in and out of the pit on a planked ramp. Foundation stones, boulders, etc., too large to be handled by steam-shovel dippers were blasted after being drilled with jackhammers operated with air furnished by a portable Chicago Pneumatic gasoline driven compressor.

After completing the general excavation over the lines of the two tunnels, two long cofferdams about 30 feet wide were made by driving steel sheet piles with McKiernan-Terry double-acting steamhammers handled by derrick and locomotive traveler booms. The 20,000-yards of excavation from the cofferdams was removed by Hayward clamshell buckets. About 3,000 tons of 14-inch Lackawanna steel sheet piles 50 to 65 feet long were used in the cofferdams. It is expected that these will be reclaimed at the end of the work.

FOUNDATION PILES

The 18,000 foundation piles were blunt-pointed, untreated yellow pine, 15 to 30 feet long and 12 to 14 inches in diameter. They were driven by the P. T. Cox Contracting Company as sub-contractor. The work of driving this enormous number of piles so closely spaced was expedited by the use of two special travelers, each provided with two stiff-leg derrick booms mounted on diagonally opposite corners. Leads 40 feet long were suspended from the booms and in each was operated a No. 9 McKiernan-Terry steamhammer. A maximum of 77 piles in 8 hours was driven by one hammer. Eleven hundred piles could be reached from one position of the traveler. Each traveler moved on a track extending across the full length of the lot and could be shifted to a new position in a very few minutes. There were also used two ordinary land pile driver towers mounted on rollers and equipped with No. 2 Warrington-Vulcan steamhammers with 3,000-pound rams and 36-inch stroke. For handling the steamhammers and operating the derricks there were used twelve Lidgerwood 2-drum and 3-drum hoisting engines. Steam for the hammers were supplied by the hoisting engines, supplemented when necessary by a stationary boiler.

CONCRETE CONSTRUCTION

As the work involved more than 200,000 cubic yards of concrete, an unusually thorough investigation was made of the economics of the construction operations and equipment. The final arrangement was the result of a study of eight tentative preliminary layouts. Every effort was made to prevent delays or breakdowns and insure continuity of operation, maximum output and low unit costs, and to reduce labor to a minimum. About $60,000 worth of special and standard plant equipment was installed for the concrete work, with the aid of the Ginsberg-Penn Co. and the R. E. Brooks Co.

TUNNEL TRENCH EXCAVATED BY CLAM-SHELL BUCKETS IN SHEET PILE COFFERDAMS.

All concrete materials, as well as timber, bricks and heavy plant equipment, were delivered by water. Provision was made for mechanically unloading and storing the material, mechanically handling and transporting all concrete material and spouting the concrete to the forms. No part of the street or of the building site is occupied by any of the plant except two tall steel masts that support the chutes. This permitted excavation, pile-driving and other operations to be carried on simultaneously with the concreting without either interfering with the other.

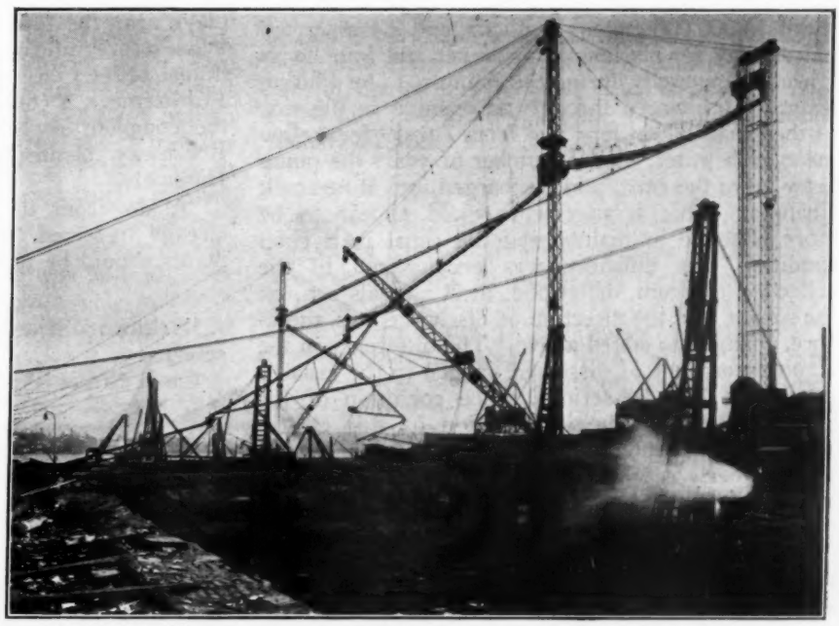
A W-bottom aggregate bin 36 feet wide on top, 220 feet long and 17 feet deep, was built adjacent and parallel to the slip. The inclined sides of the hopper are supported by inclined posts seated on transverse ground sills, thus eliminating interior ties and heavy wall construction. Two steel gantry travelers span the bin and are carried by a 44-foot gauge track 260 feet long. Each traveler has two derrick booms for unloading scows moored in the slip alongside and depositing the sand and gravel into the bin and the reinforcement bars onto the ground near the bin. Three 1-yard Blaw-Knox buckets are operated from the gantry derricks for unloading the aggregate, and each can unload a 600-yard scow in eight hours. Steel gates in the bottoms of the hoppers deliver aggregate to a 24-inch conveyor belt in a tunnel, which delivers to the boot of a pair of bucket elevators, which, in turn, discharge on to a short conveyor belt which supplies the compartments of the elevated bin which feeds the mixers. Cement is unloaded from barges and placed on slat conveyors which deliver either directly to the mixer bin or to a cement storage shed, from which bags are delivered by the same conveyor for feeding the mixer. The conveyor, bin gates and elevators are of Haiss construction.

In the mixing tower the cement bags are opened and their contents dumped into chutes supplying the charging hoppers of two Koehring 1-yard mixers; while aggregate is delivered by gravity from the bin to two Butler batchers operated by hand levers which regulate the quantity of aggregate for each batch. The empty cement bags are chuted to a bag-shaking machine which salvages about one-half of one per cent. of all the cement used.

The mixers discharge through automatically tripped pivoted chutes into 1-yard buckets at the foot of an Insley steel tower 240 feet high, to the top of which they are hoisted, where they discharge the concrete into hoppers, making the round trip in about 45 seconds. The hoppers deliver the concrete through swinging chutes to one of the two high-line chutes about 300 feet long which are carried over 14th Street and terminate at the top of two American Hoist & Derrick Company steel supporting masts 115 feet high, equipped with 100-foot booms carrying counterweight trusses. These and about 1,000 feet of standard steel chutes, hoppers, etc. that are used are of Insley make. The chutes, supported on pairs of counterweighted revolving trusses, have an effective radius about 200 feet and thus command the entire area at present under construction. They have guards of wire netting on both sides to prevent stones or large lumps spilling on workmen below, and are provided with a hand rope on each side to serve as safety lines for the patrols that inspect them and remove any obstructions.

The hoisting tower is guyed in four directions at the top and at several intermediate points. These guys as well as those to the tops of the supporting masts are anchored by special ballast boxes set in pits and having vertical and inclined transverse bents over which the guys or their bridles are deflected to their connections to the platforms carrying the ballast boxes, each of which is calculated to resist a displacement stress of 90 tons.

The 15-foot foundation slab is built in two layers. When the first has been poured the 6-foot condensation water pipes are bedded in cradles and many other smaller pipes are bedded into this concrete, and on it are set grillage beams for the columns of the steel framework of the building. The slab is reinforced with more than 2,000 tons of deformed bars in lengths up to 60 feet, most of it in straight pieces. The slab is poured in sections, each of 800 to 1,000 yards



240-FOOT HOISTING TOWER, 1,000 FEET OF STEEL CHUTES SUSPENDED FROM AERIAL CABLES, 115-FOOT MASTS AND COUNTERBALANCED PIVOTED TRUSSES.

which can be completed in a single 8-hour shift. Adjoining sections are separated by vertical construction joints made with large horizontal keys which bond the blocks together. The concrete is mixed 1:2:4, using pre-mixed sand and gravel with a maximum size of 1½ inches furnished by the Kittaning Sales Company of New York, and Atlas Portland Cement, of which about 900,000 bags will be required.

Sanitary Condition of New York Harbor

Harbor not yet seriously polluted, but part of the sewage entering it is screened and other screening plants are under construction or contemplated, including a very large one on Ward's Island

A few weeks ago Arthur S. Tuttle, chief engineer of the Board of Estimate and Apportionment, transmitted to Mayor Hylan of New York City a report as to the sanitary condition of the waters of New York Harbor made by Kenneth Allen, sanitary engineer for the Board. From Mr. Allen's report the following points of more or less general interest have been obtained.

Leading into the harbor in the borough of Brooklyn is a waterway known as Gowanus Canal, the shores of which are lined with industries discharging their waste products into it, while there is practically no inflow except a small amount of local drainage. In order to prevent the inevitable high state of pollution, it was decided several years ago to flush the canal by pumping into it water conveyed from Buttermilk Channel by a 12-foot tunnel under DeGraw Street at the head of the canal. The pump is an electrically operated screw pump with a capacity of 14,000,000 gallons per hour, and it is operated twice a day for six hours in summer and four hours in winter, generally during the ebb tide. The diluting water is discharged through an opening in the side of the canal 50 feet long and from 7 to 19 feet below mean high water. For a number of years the pump drew from the canal and discharged into Buttermilk Channel. This arrangement would appear to be more effective in maintaining the canal in a good condition, but difficulty was encountered in the collection of scum, driftwood, dead animals etc., on the screen, and the direction of discharge was, therefore, changed as stated above. The difference in the resulting amount of dissolved oxygen in the canal is not believed to be serious. The condition of the canal, because of the introduction of this clearer water and the interception of most of the sewage that formerly reached it, is much better than a few years ago, although at times it is devoid of dissolved oxygen.

To the casual observer, the harbor as a whole does not appear seriously objectionable the greater part of the time. Loss of oxygen is not apparent and the presence of driftwood is more apparent than is matter of sewage origin. With favorable tidal conditions and a fresh breeze, a person on the deck of a steamer would not receive the impression that the water was greatly polluted. However, with good illumination the body of the water may often be seen to be full of suspended particles of sewage-formed solids. In general, conditions in warm weather are less favorable than in winter. It is to be remembered that in order to avoid a nuisance at any time it is quite proper to give consideration to the worst conditions observed in each locality. A body of water clean 364 days in the year, but followed by septic conditions for one day only, should not be tolerated.

The Harlem river appears to need special attention because of its rapidly deteriorating condition. In the summer of 1909 the water of this stream contained an average of 55% of the dissolved oxygen required for saturation, but by last summer it had fallen to 20%, and there are times each year when for short periods all the oxygen has been used up by bacterial activity.

Mr. Allen summarizes the amount of treatment being given to the sewage of the several boroughs at the present time. A precipitation plant at Elmhurst, two others in Queens and four in Brooklyn constructed some thirty years ago, are both inefficient and expensive to operate, and all will probably be soon abandoned or remodelled. A contract is in preparation for remodelling the Jamaica plant into a modern one for fine screening and sedimentation, and the 26th Ward plant is being converted into a fine screening plant. In time these will probably be supplemented by means for securing a more thorough purification.

"More thorough-going improvements have been made recently by the interception of the dry weather flow from Clarkson street by a 54-inch sewer on West street to a screening plant at Canal street; the collection at Paerdegat Basin of the sewage from an area of 2200 acres; the interception of the sewage of South Beach and Midland Beach to a screening plant near the lower bay, and the delivery of the Woodside-Winfield sewage by a 13-foot 6-inch tunnel sewer to a screening plant near Bowery Bay. Furthermore, a contract is in effect for a portion of the complete sewerage of Far Rockaway and the Rockaway peninsula with a screening plant at Hammels.

"Aside from the obsolete sedimentation plants already referred to the following fine-screening plants should be noted:

Manhattan

Dyckman Street—Two 14-foot Riensch-Wurl screens.

Canal Street—*Three 6-foot Rex screens.

Brooklyn

26th Ward Plant—Two 14-foot Riensch-Wurl screens.

26th Ward Plant—*Two 22-foot Riensch-Wurl screens.

Queens

Oak Street, Flushing—Hand-cleaned perforated plate screens.

Connorton Avenue, Flushing—Hand-cleaned perforated plate screens.

43d Street, Corona—Hand-cleaned perforated plate screens.

Elmhurst—Hand-cleaned perforated plate screens.

25th Street and Riker Avenue—Two 14-foot Riensch-Wurl screens.

Hammels, Beach 87th Street—*Two 22-foot Riensch-Wurl screens.

Richmond

South Beach—Two 6-foot diameter by 4-foot Dorrco screens.

"The Dyckman street plant, installed six years ago, was the first modern up-to-date screening plant established in the city. It showed a removal of over 20 per cent. of the suspended matter when tested, which is a remarkably good figure, and through its operation, with the discharge of the effluent through a submerged outlet in deep water, the former fouling of the shore has been prevented.

"The 26th Ward Disposal Plant, Brooklyn, is being converted from a precipitation into a fine-screening plant as a first step toward a more satisfactory disposition of the large volume of sewage—now approaching 30 mgd.—collected at this point. The rapid growth of the tributary territory and of that tributary to Paerdagat and near Mill Basin and Gerritsen Basin to the west, will probably make the adoption of some specific plan for the disposal of the sewage of this entire region essential before long. With the volumes involved and the degree of treatment demanded, a large area will be required, and the land should be acquired before it becomes more fully developed.

"A small precipitation plant at Manhattan Beach, up to the present time under private operation, is in process of being taken over by the borough.

"The final disposal of the sewage now collected to Caisson Nos. 3 and 4 and the Manhattan Beach plants has not yet been settled.

"The first mechanically-operated screening plant in the Borough of Queens has just been completed at the foot of 25th street, near North Beach, with a 30-inch submerged wood-stave outlet pipe extending some 3,000 feet out into Bowery Bay. Two 44-foot Riensch-Wurl screens with ⅛-inch slots are installed with a combined capacity of 7½ million gallons per day. The tributary area, which includes Corona, Winfield and Woodside, is 7,550 acres in extent, and, although largely undeveloped at present, is increasing rapidly in population. The plant will screen all the sewage entering the Upper East river from this Borough between Steinway and Flushing Bay. The screen house is a substantial, well-built structure, which, after grading, will be beneath the street level.

"The Hammels plant for the Rockaway sewage will be equipped with two 22-foot Riensch-Wurl screens having curved 3/64-inch slots.

"In the Borough of Richmond the South Beach fine screening plant consists of a plain concrete structure containing two Dorrco screens of a capacity of 25 million gallons per day each, two electrically-operated centrifugal pumps of a capacity of 1,000 gallons per minute and a lift of 30 feet each, an emergency gas engine connected to one pump and a chlorinating apparatus with capacity to dose 2,000 gallons per minute with from 10 to 15 parts per million liquid chlorine. The operation of these two screens is a matter of considerable interest in view of their recent adoption for large installation at Los Angeles and Pasadena and at other places in California

"Other fine screening plants will soon be built at the Jamaica Disposal Plant, at Hammels in Queens, and for the New Dorp district, Staten Island.

"These screening plants remove, as a rule, but from 5 to 20 per cent. of the suspended solids. This, however, is the part of the impurities most offensive to sight and that most objectionable if stranded on the shore. For further purification some form of tank treatment is necessary. The screening plants are, as a whole well kept and free from odor. At Dyckman street screenings are removed with the garbage; at the Queens plants they are generally consumed in small oil incinerators, while at South Beach they are buried in nearby waste land. At Canal street provision is made for removal by truck or by scow. From a sanitary point of view any one of these methods is satisfactory if properly carried out."

The enormous crowds that pour into Manhattan every morning introduce new problems of house drainage and sewerage that cannot be satisfactorily solved until more information has been obtained as to the volume and hourly variation in the waste they produce. Such information is necessary for a proper design of the capacity of both sewers and treatment plants.

The new sewage treatment plants will aid in maintaining the waters near their respective outlets in a presentable condition but will not have an appreciable effect upon the pollution of the harbor as a whole. An important step and one that will have far-reaching results in bettering the condition of the harbor will be the thorough treatment of a large volume of sewage on Ward's Island. It is estimated that by 1960, 187,000,000 gallons per day could be collected at this point and treated and the effluent discharged into Hell Gate. This island is now under state control, but an effort is being made to have the State legislature pass a bill providing for the reversion to the city of about 50 acres at the southern end.

*Under contract.

Flow of Sludge in Pipes

Experiments on the friction head of sewage sludge flowing in pipes have been conducted at Wolverhampton, England, and were described by William Clifford, manager of the sewage works there, before the International Conference on Sanitary Engineering. These experiments were conducted in 4-inch wrought-iron welded pipe using different lengths up to a maximum of 3,900 feet and a velocity of 2.5 feet per second. The friction head at this velocity varied from 21 feet to 29.9 per thousand feet of pipe.

The experiment showed that sludge containing 96% to 97% water had practically the same friction loss as clean water, but this increased rapidly as the water content decreased below 90%. Reference is made to experiments by the Syracuse Intercepting Sewer Board on the friction losses of sludge flowing in a 12-inch pipe,

such losses when the velocity was maintained at 5 feet per second varying from 6.94 feet to a thousand foot length of pipe for clear water up to 11.97 feet for sludge with a 90% water content.

Tunnel Hauling with Ford Trucks

In the recent construction of an outfall sewer at Los Angeles, Calif., small Ford trucks were used for bringing in the concrete aggregate, which use is believed to be unusual in tunnel work. The tunnel had a width in the clear between timbers of 14 feet and a height of about 13 feet. It was driven through sand and other loose soil and tight lagging was, therefore, required throughout. The tunnel was lined with concrete giving it a finished section 10 feet 6 inches high and 12 feet 3 inches wide at the springing line. The wooden forms were set up in panels 5 feet long and 2 to 3 feet wide, bolted together to form a complete section. Concrete was mixed in the tunnel and placed behind the forms by means of a pneumatic concrete gun.

The cement, sand and stone had to be brought into the tunnel. Even with the smallest truck there was not room enough for the truck to pass the mixer, and, moreover, it was necessary to turn the truck around before it could leave the tunnel. A standard Ford truck equipped with a dump body requires a clearance for turning, even on a turntable, of between 15 and 16 feet. Accordingly the contractor decided to shorten the standard Ford truck by nearly 2 feet, which was done by cutting out from the middle of the frame and the drive shaft and its housing 22 inches of material and rejoining the parts. This brought the body forward and necessitated moving the dashboard forward, raising the steering wheel to a more nearly vertical position and placing extensions on the control pedals so that the truck could be driven conveniently from a narrow and higher seat built immediately in front of the dump body. On the completion of the tunnel work the wheel base of the trucks can again be increased to standard length at a cost of about $50 each.

These trucks were equipped with Lee dump bodies with two batch compartments, each with a capacity of 18 cubic feet. The two compartments were loaded with aggregate and cement at the tunnel portal and driven into the tunnel and on to a turntable immediately in front of the mixer. Here they were turned about 180 degrees and the material from the two compartments in succession dumped into the skip of the mixer. The width of the tunnel was sufficient to allow two of these trucks to pass each other so that there was no difficulty in maintaining a constant supply of concrete material. The average day's run was 60 feet, requiring about 200 cubic yards of concrete, while the maximum rate was 240 cubic yards in 7½ hours.

The turntable used by the contractor was built up of two 10-inch 15-pound channels spaced 4 feet 10 inches apart on an inverted 12-pound rail bent to a circle 9 feet in diameter. This rail rested on eight 6-inch by 2¼-inch ballbearing rollers that revolved on 1-inch shafts which ran from a central spindle to bearing just beyond the rollers, which bearings were in turn carried by a 3-inch 4-pound channel bent to a circle with a diameter of 9 feet 4½ inches, the channel being supported by two 5/16-inch plates 18 inches wide, 10 feet long and spaced about 6½ feet apart, which acted as skids for moving the turntable. These plates also supported two transverse channels that carried the central spindle. The two 10-inch channels on top acted as runways for the wheels of the truck. They were only 10 inches above the ground, and the automobile reached them by movable wooden ramps placed in front of the turntable.

The trucks worked satisfactorily until the length of the tunnel became so great that there was difficulty in preventing the carbon monoxide from the exhaust gases becoming dangerous to the workmen. To meet this difficulty the contractor, The J. Benjamin Fahy Company of Los Angeles, placed a combustion chamber on each truck in place of the usual exhaust pipe. The combustion chamber consisted essentially of a sheet iron cylinder covered with asbestos and lined with firebrick and equipped with a spark plug connected to the ignition system of the engine and also having a valve for the admission of air. The engine's exhaust gases entering this chamber were mixed with the air and completely burned to carbon dioxide before being exhausted. The concrete mixer was being driven by a gasoline engine and a similar combustion chamber was installed in this engine also.

Economy of a Sewerage System

It is certainly an unsanitary and obsolete practice for a large city to use cess-pools and privies instead of a sewerage system, as was done in Baltimore previous to 1911. Furthermore, little can be said for the economy of such a practice. If the additional expense which must result from an increase in sickness and disease is not considered, the building and maintaining of cess-pools and privies is expensive A first-class cess-pool costs about $75 to $100 whereas the cost of an 8-inch lateral sewer with a 5-inch house connection for a 50-foot lot will average from $75 to $150. This cost does not include the cost of building intercepters, outfall sewers, or a treatment plant. The annual cost of cleaning cesspools will average about $5.00 each or about $1.00 per person. The annual cost of treating sewage at the Baltimore plant is between twenty and twenty-five cents per person, and the total cost per person of operating the entire sewerage system is between sixty and seventy cents each year. *M. J. Ruark and C. E. Keefer in paper before Am. Soc. for Municipal Improvements.*

Oiling for Mosquito Control

Controlling the multiplication of mosquitoes by maintaining an oil film on the surfaces of pools and other bodies of water that cannot be drained has been practiced quite extensively in the South. Recently a new method has been employed by the Health Department of Newport News, Va., which is considered more effective and cheaper than those used before.

A mixture of equal parts of kerosene and waste crankcase oil is used, owners of large garages being glad to deposit this waste oil in iron drums that are left with them by the Health Department. Sawdust from sawmills in the vicinity is placed in a large vat or oil-tight box and the mixture of kerosene and crankcase oil is poured over the sawdust and allowed to stand for four or five days to thoroughly saturate it. The sawdust is then removed and fresh sawdust and oil placed in the vat. The saturated sawdust is carried in canvas bags that have been rendered oilproof by five applications of Johnson's waterproofing, these bags being provided with a strap so as to be carried conveniently by passing the strap across one shoulder. The sawdust is broadcast on the water as a farmer would sow grain. It sinks to the bottom immediately and the oil is released from the sawdust gradually for four or five days following. This keeps the surface covered with oil even though wind should blow the film to the leeward side of the pool or stream.

By this method not more than two-thirds as much oil is required and one man can cover as much area as two can cover using spray cans. Moreover, the film is more permanent and the application of oil can therefore be made at longer intervals. One modification of this plan suggested is to place boxes full of the saturated sawdust at suitable intervals in the bottom of a slowly flowing stream, thus keeping the surface of the stream covered, where the current would at once remove oil that had been sprayed on.

Underground Structures in Astoria Streets

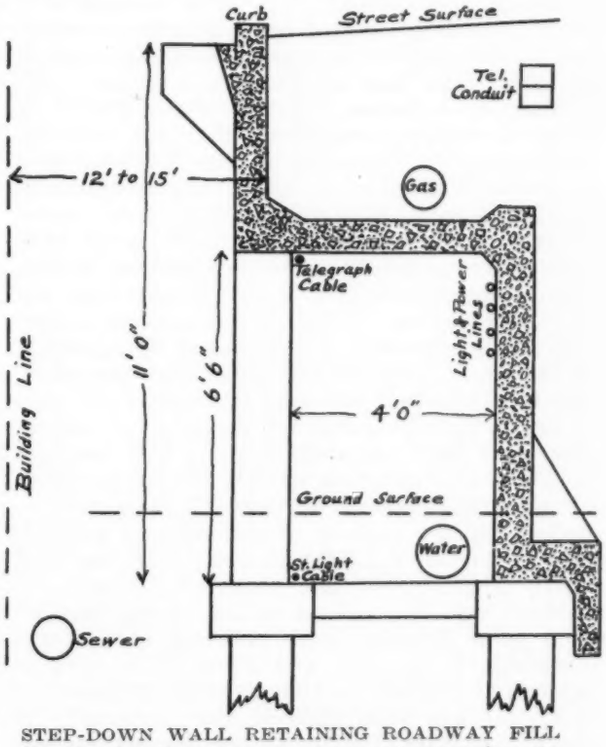
By R. A. McClanathan*

In the reconstruction of the business portion of the city of Astoria, Ore., forty-two blocks of which were destroyed by fire December 8th, 1922, and which is located on filled ground with the elevation of the streets from 8 to 12 feet above ground elevation, we adopted an unusual plan for building the retaining walls holding the roadway fill and supporting the sidewalk. (This was described in the January, 1925, issue of PUBLIC WORKS.) This plan not only economized in the amount of concrete required in the retaining wall and also the amount of fill required in the roadway, but gave a conduit in which are located lighting and power cables and water mains. The gas mains are placed nearer the surface, in the fill just above the horizontal part of the step-down wall.

Where streets are of sufficient width to allow for parking space between the curb and walk, we lay all pipes in the parking space except main trunks; and where the streets are narrow, as for instance a 40-foot street with a 20-foot pavement and 5-foot walks on each side, laid next to the curb, we lay the pipe in the 3-foot space left between the walk and the street lines. Water pipes that are 12 inches diameter or over are laid under the pavement 2 feet out from the back of the curb, which gives a chance to tap the pipe from the parking space without disturbing the pavement. Mains and hydrants are placed on one side of the street and 2-inch pipe on the opposite side for domestic service only.

All trunk-line sewers are laid under pavements, usually in the center of the street, with 6-inch and 8-inch laterals laid on each side of the other streets back of the curbs and under the walk if necessary. Large gas mains are placed under the pavement and small mains back of the curbs, usually on both sides of the street.

The cost of laying two gas pipes is very little more than the cost of laying service pipe across the street, while the cost of repairs and replacement is very much less. The cost of the additional line of water pipe is very little more than the cost of services across the street and here also the cost of repairs is much less. In the case of sewers, the cost of the additional line is greater in proportion than for the water pipe, the additional cost of this construction being about 25%.



STEP-DOWN WALL RETAINING ROADWAY FILL
Showing location of sewer, water and gas mains, etc.

*City Engineer of Astoria.

Detroit Sewage Treatment Committee

Mayor Smith of Detroit, Mich., has appointed a committee of five local engineers, to serve without pay, to investigate the problem of the collection and disposal of the sewage of that city. The commission is authorized to call on any city department for information. The mayor asked the Associated Technical Societies of Detroit, the Detroit Engineering Society, and the local sections of the national engineering societies for suggestions as to membership on the committee, and appointed Albert C. Marshall, vice-president of the Detroit-Edison Co., as chairman; Francis C. McMath, director of the Canadian Bridge and Iron Co.; Lewis C. Rogers, chief engineer of the Solvay Process Co.; George R. Cooke, contractor, and Perry A. Fellows, engineer with Frederick Stearns & Co.

Garbage Collection in Milwaukee

The total cost of collection of garbage in Milwaukee during 1924 was $190,000, less the cost of commercial collection which is self sustaining, or a net total of $175,000. This is $69,000 less than in 1923. Collection of garbage by truck-drawn trailers is said by Mr. Stoelting, commissioner of public works, to have more than fulfilled the early claims for the system. In addition to lessened cost, the number of complaints concerning garbage collection have been greatly reduced.

Approximately 60,000 tons of mixed refuse and garbage were incinerated at the municipal plant during the year at a cost of $140,000, or $2.30 a ton.

Refuse Disposal in New York

Greater New York has made considerable progress during the past few years in providing for incinerating its garbage and rubbish—more, probably, than most of its citizens realize. According to a recent bulletin of the Board of Estimate and Apportionment, there are now ten incinerators in operation in the different boroughs, with three more under construction and six authorized. Those in operation or under construction have a combined capacity of 1,520 tons per day, while those authorized have a combined capacity of 1,350 tons. Even these are only a beginning, however, of the plant necessary for incinerating all the rubbish and garbage of the city. The collection of rubbish and garbage in Manhattan amounts to about 5,000 tons a day, while the combined capacity of the incinerators built and authorized in that borough is 1,200 tons. In Brooklyn only 200 tons capacity of incinerators are in service and none authorized, while the amount of rubbish and garbage produced is about 1,000 tons a day. During 1923 nearly 1½ million cubic yards of garbage and rubbish was disposed of at sea, being dumped at a point 22 miles east-southeast of Scotland Lightship in summer and about 13½ miles in winter, if carried to the distance required by law. (It has been claimed that, especially in stormy weather, the scows are dumped considerably short of this distance.) The location, type and capacity of the incinerators referred to are given in the accompanying table:

INCINERATORS FOR THE DISPOSAL OF RUBBISH AND GARBAGE IN GREATER NEW YORK

Location	Type	Capacity in tons per day
Manhattan		
W. 56th St. 12th Ave.....	Decarie	300
*E. 139th Str. & Harlem River.	Sterling	300
Brooklyn		
Georgia Ave.	Sterling	100
Avenue W and W. 9th St.....	Heenan-Froude	100
Queens		
Long Island City.....	Decarie	100
Maspeth	Decarie	100
Flushing	Decarie	100
Jamaica	Decarie	100
*Bergen Landing.....	Decarie	150
Arverne	Decarie	70
Richmond		
West Brighton.....	Heenan-Froude	50
Clifton	Heenan	50

*Under construction.

In addition to these, incinerators have been authorized at the following locations:

Location		Capacity in tons per day
Manhattan	East 73rd Street	300
	Stanton St.	300
The Bronx.....	Hunts Point	300
Queens	Betts Ave.	150
	Hammels	150
Richmond	Great Kills	75*

*To be increased to 150 later.

Alley Paving as a Health Measure

In Reading, Pa., the unusual condition exists of alley paving being performed at the demand and under the supervision of the Bureau of Health.

This condition is brought about because of the fact that all of the alleys in Reading are private, none of them being recorded as public thoroughfares. The city, therefore, has no jurisdiction over them as thoroughfares. However, when the Bureau of Health finds unsanitary conditions in an alley, they notify the property owners that these must be remedied and recommend, as the only permanent remedy, the paving of the alley. As a great many of the owners use the alleys as entrances to their garages, there is seldom any difficulty in securing consent to the paving. The actual work is done under contract awarded by the City Council but supervised by the Bureau of Health. Being private ways, there are, of course, no established lines and grades, but these are fixed by the city engineer to meet the topography and other existing requirements.

In 1923 a new method of construction was adopted. A strip of concrete 3 feet wide was built down the middle of the alley dished in the center so as to serve as a gutter. After this middle strip has set, the remainder of the concrete pavement is laid from it to the fence on each side of the alley, a pre-molded joint filler being set along each side of the central strip. This concrete pavement is now made 7 inches thick but was only 6 inches prior to 1924. One advantage of this construction is that many of

the houses drain their kitchen sinks and other waste water into the alley, and the central gutter strip carries this waste water while the two side strips are being laid, thus eliminating much of the difficulty found when endeavoring to lay the whole pavement at once. Under this new method of construction contract prices are about 40c per square yard less than under the previous method.

The city pays for the pavement but is reimbursed by the property owners by a special assessment spread over a period of years. The city maintains a revolving fund from which the money for alley construction is drawn.

St. Joseph Municipal Asphalt Plant

Small-capacity plant saves city twelve thousand dollars in three months and secures prompt repairing whenever needed

For a number of years St. Joseph, Mo., maintained its asphalt pavements by contract, payment being made on the unit price basis. The contractor was in the habit of doing this work when not busy with more extensive jobs, and the plan finally had to be abandoned because the city was not able to carry on the repairing with any kind of system and the cost became too great. Small holes became large ones before they were repaired, which not only was inconvenient to the traffic, but materially increased the cost of the repair. In 1922 the city decided to obtain and use its own asphalt plant and placed the matter in the hands of W. K. Seitz, the city engineer. Mr. Seitz describes the plant in a brief article in "Kansas Municipalities," from which the following description is taken:

The plant was built with the following objectives in mind: First, that it should be complete in every detail so that the product would equal that produced by any commercial plant. 2. That the maximum output should not exceed 500 square yards of 2-inch pavement in 8 hours, so that no contractor could persuade the city officials to lease it to him for contract work, since such capacity is too small for construction work in competition with larger plants. This limitation was accomplished by providing a comparatively small sand dryer. 3. That it should have a large storage capacity for hot sand so that laborers could get a supply ahead and then be transferred to work on the streets. 4. That an asphalt kettle of large capacity be provided, for the same reason. 5. That the plant be so equipped that an engineer with one helper could operate the plant bin and asphalt kettle when filled. 6. That it be completely enclosed so as to preserve the machinery and permit it to be locked up when not in use. 7. That the entire structure be made fireproof.

These objectives were accomplished by driving the sand dryer, the cold and hot sand elevators and the mixer with a 30-horsepower electric motor, each of these having a clutch by which it might be cut out when not in use. The sand was heated with fuel oil. The asphalt was heated with coal and delivered to the mixer with a centrifugal pump. A separate boiler was provided for operating the asphalt pump, supplying steam to the jackets along each pipe carrying hot asphalt, and operating the air pump for the oil burners. The accompanying diagram is a section of the plant showing the general arrangement.

The cost of the plant erected, including the building, was $16,164.17. In addition, the city purchased two 5-ton tandem rollers, one gasoline and one steam, at a cost of $3,075.50 each; two fire wagons with small tools for $236.67; and three 1½-ton trucks with dump bodies for $6,185.50, a total cost of $28,737.34. With this equipment the city is able to maintain two repair gangs which repair all classes of asphalt, concrete and brick pavements. At present the area of asphalt under maintenance is 706,300 square yards (which will probably be increased to 1,000,000 square yards within the next ten years), while the amount of concrete and brick combined is about the same.

During a 75-day period last summer, while only one gang was working, the total cost was $9,129.88, of which $4,404 was for labor, $2,658 for cement, sand, dust and asphaltic cement, $485 for fuel and oil, $82 for electric current, and $1,500 for depreciation and anticipated repairs on plant, trucks and rollers. This gang during this time laid 865 tons of sheet asphalt, making 11,500 square yards of repairs, at a cost of $10.56 per ton laid or 79.4c per square yard. The repairs were small breaks, few having an area of more than a square yard. With two gangs working the cost per yard would, of course, be less, the reduction probably being between 10c and 15c per square yard.

Said Mr. Seitz: "At just what yardage or under just what conditions a city is justified in building a plant of this character is, of course, subject to a wide variation. In our case, there can be no question that the time had arrived, for we were paying on an average $1.85 per square yard for this work." According to the above figures, he calculates the saving in the

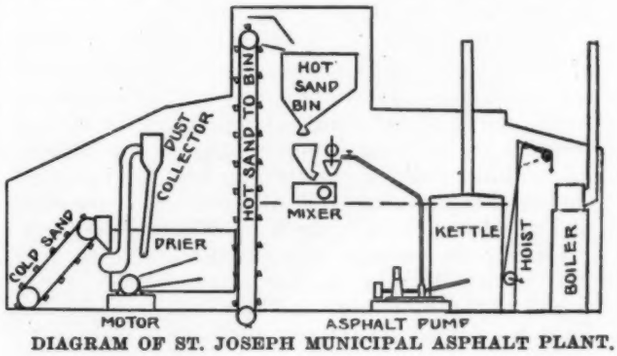


DIAGRAM OF ST. JOSEPH MUNICIPAL ASPHALT PLANT.

75-day period as $12,147. In addition to this actual saving, the work was done promptly, which added greatly to the convenience of the community. "The advantages of a plant of this kind are: 1. The quality of the product is such that it holds up under traffic. 2. The plant cost is remarkably low. 3. The machinery is substantial and protected, and there will be no further capital expenditure for a number of years."

Asphalt Repairs in Dayton

The Division of streets of Dayton, Ohio, will begin as soon as possible this Spring extensive repairs of its asphalt streets which have been down for from twenty to thirty years. In addition, a number of brick paved streets will be resurfaced with asphalt, it being proposed to cover in this way a total area of 37,571 square yards.

It is proposed to contract with the Equitable Asphalt Maintenance Company for the lease of one of their surface heater machines, for which a fixed charge is made of 10c per square yard for the first 36,000 square yards laid and 5c per square yard for all over that area.

In January bids were received by the purchasing agent for the year's asphalt requirements, estimated at 900 tons, and the bids ranged from $21.20 to $31 a ton in tank car lots. Last year all asphalt was purchased in drums, but an industrial siding has now been completed into the city yards and the material will be received in tank car lots at a saving of $4 a ton, or about $3,600 per year.

Hygroscopic Salts on California Highways

Test of dust preventives on thirty-two miles of highway under widely varying conditions. Conditions under which successful

What is considered by H. S. Comly, division engineer for the State Highway Commission of California, as a severe test of calcium chloride and magnesium chloride as dust preventatives has been carried on by Division II during the past three years on crushed rock and gravel surfaced state highways in California.

The salts have been applied to about 32 miles of highway in various amounts and under different conditions of road surface and atmosphere. In all, parts of 115 miles of highways have been treated, these lying some in large open valleys, in foothills, rugged country, in arid land and on timbered mountains well watered with streams; and at altitudes varying from 500 to 3,500 feet.

During the summer months the humidity over this entire division is not large. Dew is not found in the mornings and fog is practically unknown—a most severe test for hygroscopic salts.

The material first used was commercial granulated calcium chloride containing 75% pure hygroscopic element. This was first applied in July, 1922, at the rate of 2½ pounds of commercial salt per square yard on a surface of crushed rock which had become permeated with a red sedimentary soil having a large clay content. This amount was applied in two applications ten days apart and for a month thereafter the surface was sprinkled at intervals of one week. The treatment seemed effective during the remainder of the summer until just before the fall rains set in. The following spring one pound per yard was applied during the period of spring rains and the road remained smooth and dustless throughout the following summer with a traffic of more than 1,500 vehicles a day. A stretch of road immediately adjacent cost the state $700 per mile during that summer for sprinkling and dragging in an only partially successful effort to hold the road under the same traffic.

During 1923 and 1924 applications were made to other sections, one surfaced with moderately hard slate rock, another with gravel mixed with sand and clay, another with crushed gravel.

The cost of applying hygroscopic salts, using equal amounts of their anhydrous elements per square yard of surface, is practically the same for each material mentioned. Exclusive of providing binder for the surface, and using a strip 20 feet wide and 2.6 pounds of the anhydrous element per square yard for the first year, the cost amounted to $900 per mile of road. The cost of applying about 1 pound of the anhydrous element each succeeding year would be about $300 per mile. Apparently the process may be continued effectively for an indefinite period, but considering it effective for three seasons only gives the average summer maintenance cost of $600 per mile. The pavement so treated will stand up under a traffic of 1,500 vehicles per day. Maintenance of gravel and crushed rock roads under this volume of traffic by the ordinary means of sprinkling, dragging and adding new crushed rock will cost on the average more than $1,000 per mile per summer, and the road will still be dusty and uncomfortable.

On the basis of the experiments Mr. Comly has drawn the following conclusions:

"The use of hygroscopic salts is an effective method of maintaining gravel or crushed rock roads subjected to a heavy volume of traffic. The amount required and consequently the cost will depend upon the humidity of the atmosphere. The judicious use of a suitable binder for the rock surface is essential to effective results in the dryer atmospheres and an aid to good results in more moist atmospheres.

"It is highly essential that a road surface be provided which, with the moisture secured through the agency of the salt, will form a structure thoroughly resistant to the suction of rubber-tired vehicles. If the road surface is such that the small amount of water drawn from the air will not produce this result, the effectiveness of the treatment will be lost.

"It is not reasonable to expect, therefore, that this treatment will be effective on a surface of small gravel or rock alone, except possibly in the most humid atmospheres. In preparing the surface, however, care should be exercised not to use an excessive amount of clay-like binder as the result in wet weather may prove undesirable."

Widening a California State Highway

By A. W. McCurdy, Assistant Division Engineer

An interesting feature of the widening work between Greenville and Livermore, Alameda county, California, recently completed, was the plan adopted for super-elevation of curves where the original pavement had been placed without this modern improvement in road building.

For 4.3 miles between these two points, the existing fifteen-foot concrete pavement was widened to twenty feet by laying flush concrete shoulders 2½ feet wide and seven inches thick. The roadway width was graded to thirty feet and in some places thirty-four feet by addition of excess material from excavations.

The super-elevation was provided for on curves by using the surface slope for one-half of the old pavement as a base, and drawing a line that would raise the grade of the shoulder on the outer side of curves approximately seven inches above the grade of the shoulder on the inner side. The resulting wedge, or space left between the edge and grade of the new shoulder and the surface of one-half of the old pavement, was filled with asphalt macadam.

The latter work was done by state forces after completion of the shoulders by the contractor. Long run offs at each end of the curves accomplished the transition without sharp changes in grade. State forces also lengthened the existing pipe culverts and made necessary excavations and embankments before work was commenced on subgrade operations for paving.

In preparing subgrade, the contractor used a 30-h.p. tractor with scarifier and blade and all excavation was made to rough subgrade by this method. Much of the finished grade was done by a specially constructed Carr type grader. Some hand finishing was required where the edge of the new shoulder extended under the edge of the old concrete pavement. This was done to seal the joint and strengthen the edge of the existing concrete slab.

A central mixing plant was used by the contractor, the equipment consisting of a three-sack Chicago-Smith paver with Johnson batch hoppers. Aggregates were hauled directly from their source in Niles canyon and the mixed concrete was hauled to the point of use in Ford trucks, equipped with a specially designed body that permitted dumping from either side.

An unusual method of tamping was employed in finishing the concrete, which proved most successful. A hand tamper sixteen feet in length with plow handles was made, similar to former models used on concrete work. The ends of the tamper were notched to allow of bearing on a 3-inch by 8-inch plank placed at right angles from the edge of the existing pavement to the header board. Care was taken to place one end of the plank at such places on the old pavement that in longitudinal finishing the surface of the shoulder would match flush, as close as possible to the grade of the present pavement surface.

As the tamper was moved ahead, a lap of three feet was made in finishing to insure a smooth riding surface.

Wet burlap was used for curing the new shoulders. It was used in rolls seventy-five feet long and, after being placed over the concrete, was kept wet with frequent use of a hose.

Earth shoulders were graded to the edge of the new shoulder and the entire roadway crowned to match the existing pavement. The result is a much improved condition and a roadway adequate to handle for some time, it is hoped, the rapidly increasing traffic on this section of the highway.

W. A. Dontanville was the contractor and M. C. Fosgate, resident engineer. The improvement cost approximately $54,500, or $12,680 per mile.

Paving in Milwaukee

During 1924, according to the report of R. E. Stoelting, commissioner of public works, of Milwaukee, Wis., that department made 385 contracts aggregating $3,000,000, of which $1,500,000 was for street, sidewalk and alley construction. In addition, the city forces resurfaced 277,382 square yards of macadam streets with bituminous macadam at an average cost of about 73c. a square yard. The contract prices for the various pavements averaged $5.75 for granite block, $5.33 for brick, $2.68 for asphaltic concrete, $2.55 for vibrolithic, $2.71 for cement concrete, $3.71 for sheet asphalt and $2.22½ for cement alleys. Vibrolithic concrete led in quantity, 9.7 miles having been laid. In addition, there was 1.79 miles of asphaltic concrete, 1.55 miles of asphalt and 1.43 miles of cement concrete.

MAKING THE HIGHWAYS SAFE — AERIAL PHOTOGRAPH OF GRADE CROSSING ELIMINATIONS ON THE SAN DIEGO COAST.

The new pavement between Encinitas and Cardiff has been constructed on the west side of the Santa Fe railroad, doing away with both crossings and reducing the number of curves from eleven to four and lowering the maximum grade from 7.10 per cent to 4.75 per cent. Distance shortened 350 feet. Photo by U. S. Air Service.

Traffic and Paving Costs

Problems presented to City Managers and Engineers discussed by W. W. Horner. Assessing costs of paving for heavy traffic

Under the title, "How Modern Traffic and the City Plan Affect Distribution of Paving Costs," W. W. Horner, chief engineer of sewers and paving of St. Louis, describes in the "National Municipal Review," the method employed by St. Louis in distributing the cost of the street paving among her citizens. The chief points are given in abstract below.

Municipal engineers are required to solve not only the problem of providing a pavement suitable for traffic, but also, in cooperation with other municipal officials, that of producing the funds required and of supplying them from the sources most directly benefited.

The first problem for the city planner and paving engineer is to provide proper traffic ways which will lead traffic into well defined and properly regulated channels. These traffic ways may be developed entirely through the provision of a proper pavement on existing well-aligned streets, or by opening new and widening existing thoroughfares. Either solution presents a problem in pavement engineering, the solution of which will invariably result in a pavement charge much in excess of that required for a local residence street. An average cost of first-class pavement on a 30-foot residence street today is about $10 per front foot, this including well-dressed granite curb and bituminous-concrete surface on a concrete foundation. On the other hand, special traffic ways for heavy haulage will require 36 to 40-foot roadways with concrete foundations about 3 inches thicker and granite block wearing surface, the cost of which will average approximately $20 per front foot; while pavement for the intermediate heavy traffic ways will hardly cost less than $15. The paving projects must, therefore, be divided into two fairly distinct groups. The unusually expensive pavements are invariably of general city-wide benefit in addition to that incident to the paving of the average street, and recognition of the excessive cost if the whole of this is charged to the abutting property would justify modification to common methods of distributing the expense by special assessment.

St. Louis has tried in succession several forms of paving assessment procedure. Prior to 1876 all costs were paid by the city by the sale of bonds and pro-rated against abutting property on a frontage basis and collected with the general taxes. From 1876 to 1902 special tax bills were issued to the contractor, the assessment still being pro-rated on abutting frontage. From 1902 to 1914 one-quarter of the cost was charged to abutting frontage and three-quarters on an area basis against property extending midway to the next public street. In 1914 this was changed so that one-third was assessed against the frontage and two-thirds on an area basis within a taxing district, the limits of which were decided by the Board of Public Service.

This last procedure, which is now in force, has been complicated by three factors. One is that the municipal forces do all repair work, using a city municipal asphalt plant, and because it is difficult to draw the line between repair work and resurfacing, the latter is frequently done by municipal forces and in a few instances the pavement is practically reconstructed; in which case the property holders secure what is practically a new pavement without being assessed therefor.

The second complication arises from the local gasoline tax. About five years ago St. Louis began levying a tax of ½ cent a gallon on gasoline for automobile use and agreed to set aside the money so derived for repairing important traffic ways under the general supervision of an informal committee composed of city officials and representatives of the various automobile and gasoline interests. Here, too, the line between repair and reconstruction being indefinite, in many instances these funds have been used for reconstruction.

Thirdly, in 1918, following pavement neglect during the war period, a paving bond issue of $360,000 was passed and the money used for resurfacing, this in some instances including reconstructing foundation and curb as well as new surface.

This so-called "free paving" has amounted to less than 10% of the annual program, but developed much complaint by property owners not so favored. In preparing for the $87,000,000 general bond issue of 1923 a policy was developed establishing a basis on which the money was to be expended. This policy was as follows:

First. No single street of any character will be paved outright from the proceeds of these funds, except small triangles and cut-offs, which are a part of the major street plan and which are so situated that the assessment of the paving could not be equitably worked out.

Second. No wearing surface will be paid in any part from these funds, but must be carried through entirely by special assessment.

Third. The funds will be applied only toward paying a part of the cost of the paving of major thoroughfares or special heavy traffic ways. They will be furnished as an aid to these projects in amounts varying from 25 to 50 per cent, as the board may determine upon the consideration of the particular conditions surrounding each improvement.

Fourth. About half of the money is to be used as an aid to the repavement of existing thoroughfares and the remainder to assist in the original paving of new thoroughfares being opened or widened under the city plan.

This policy has not been embodied in a definite ordinance, but is being rigidly followed. In deciding which projects shall receive city aid, the Board considers the extent to which the paving of a given thoroughfare may benefit the city at large; to what extent it will permit the appre-

ciation of values of abutting property; and the excess of the cost over that of paving a purely local street.

In some instances it was evident that the increase in property value due to the new pavement was so rapid that a paving assessment of $25 per front-foot would not represent a serious burden, and little aid from the bond funds was extended. At the other extreme are thoroughfares connecting isolated civic centers where the traffic demand is urgent and the property traversed is entirely undeveloped; in some of which cases even a slight assessment would approach confiscation. Here it is proposed to construct concrete roadways at the foundation grade of the future pavement, but build them of such character that they will provide satisfactory service for the next few years. The cost of these roadways will be paid entirely out of the bond funds, but the cost of final widening and surfacing will ultimately be charged against the adjacent property, but not until it has had an opportunity to develop. Intermediate between these are newly established thoroughfares which apparently will not change the use or the value of the abutting property materially; in which cases it is probably reasonable to pay the cost in excess of that of paving the street if of normal width and suitable for light traffic.

SPREADING ASSESSMENTS

The St. Louis system of spreading the assessed cost in part on the frontage and in part on adjoining areas also has much to recommend it. A strict frontage assessment, unless modified in some such manner undoubtedly works serious hardship on corner lots and would in many cases amount to confiscation.

In assessing corner lots, paving of the street on which main access to the property lies is assessed for the full frontage and full depth, but when the cross street is paved, it is assessed for the full frontage and only the lateral depth. The present distribution of cost by one-third frontage and two-thirds area might be improved by further diminishing the frontage assessment to possibly 20% of the whole.

Under this procedure and on the assumption that the maintenance and gasoline tax funds be restricted entirely to repairs, it is felt that the city will be following a sound policy in pavement finance which will recognize the changed conditions due to present traffic and which will make possible the paving of our major thoroughfares without undue hardship or injustice to the property in the vicinity.

Mr. Horner discussed a suggestion made by Mr. Pennybacker that payment for paving by special assessment was unjust, but that it should be included with the general revenue and would be covered by increase in valuations. He stated that experience in St. Louis showed definitely that only in rare instances would increased property valuations pay the interest charge on the paving cost. He also questioned whether under this plan the distribution of cost would not be quite as unjust as under the assessment plan. Under the latter the abutting owner pays for pavement from which the whole city receives more or less benefit, but under the general taxation plan the owners of property on residence streets would pay an undue share of the cost of the more expensive pavements on thoroughfares and in commercial districts. He believed that the St. Louis plan occupies the middle ground between the two extremes and secures results with the least possible inequality.

Production of Public Utility Power

During the past five years the annual production of electricity by public utility power plants in the United States has increased more than 50%, according to the figures prepared by the U. S. Geological Survey. This statement and other figures given below are based on reports from about 4,000 power plants, each producing 10,000-kwh. or more per month, engaged in generating electricity for public uses. These represent about 95% of the total capacity of all plants of the kind in the country, and the figures for the remaining four or five per cent are estimated.

There has been a continuous increase in power production except during the year 1921, when this was 6% less than in 1920.

Dividing the total power into that derived from water, coal, fuel oil, and gas, we find that water power constituted 37.5% of the total in 1919 but has diminished continuously until it was but 33.9% in 1924. However, the total in the latter year was nearly 40% greater than in 1919.

The amount of coal used for this purpose has not varied materially, having fallen off in 1921 and again in 1924 and increased during the other years. The consumption in 1924 was 37,483,000 short tons as compared to 35,100,000 short tons in 1919.

Fuel oil has shown considerable increase each year except 1921, when all sources of power showed a decrease. The consumption of fuel oil by power plants in 1924 is slightly more than 50% greater than in 1919.

The greatest growth, however, has been in the use of gas for such plants. It increased from 21,406,000 M. cubic feet in 1919 to 48,520,000 M. cubic feet in 1924, or more than 2¼ times.

An interesting and encouraging comparison is that of the consumption of fuel per kwh. of output. In making this comparison oil and gas were reduced to equivalent amounts of coal and the total fuel expressed as tons of coal. Expressing the consumption per kwh. as percentage of the 1919 rate, we have the consumption reduced to 94% in 1920, 84% in 1921, 78% in 1922, 75% in 1923 and 69% in 1924. In pounds of coal per kwh. this means a reduction from 3.2 pounds to 2.2 pounds, or 1 pound of coal per kwh. saved. This means that there was a saving last year of nearly 17,000,000 tons of coal due to the increased efficiency of this class of power plants.

Staunton Water Supply Project

By Willard F. Day, A. M. Am. Soc., C. E.*

Surface supply being provided by construction of concrete dam. Construction of tunnel fifty-seven hundred feet long shortens conduit from reservoir to city by eight miles

The City of Staunton, Virginia, is now engaged in the construction of a new water supply at a cost of approximately three-quarters of a million dollars, which, when completed, will insure an ample supply of soft water, flowing by gravity, for many years to come.

The present supply is derived from eleven springs, located in Gypsy Hill Park, lying within the city limits. This supply was developed in 1875, and produces a clear, odorless water of extreme hardness, with a distinct limestone taste. In quantity the present supply is deficient for the City's needs, and its hardness precludes rating it as "first-class," particularly for industrial use.

The new supply is from the waters of North River, a typical mountain stream, lying in the Shenandoah Mountains, fifteen miles northwest of Staunton. The watershed area is twenty-seven square miles, all within the Shenandoah area of the National Forest.

At a suitable site a concrete dam, forty feet high and four hundred feet long, will impound one hundred and fifty million gallons of water, submerging thirty-five acres. Test borings of the foundation, made by the Longyear Exploration Company of Minneapolis, indicated a satisfactory foundation of sandstone at depths ranging from three to eleven feet.

Coarse aggregate for the concrete is obtained by crushing the local sandstone, and fine aggregate is made by passing the crushed stone through rollers which reduces it to a sand of proper size and grading. The concrete is to be handled and poured by a 160-foot tower and chuting system. A stiff-leg derrick at the quarry places the plums in cars which are brought within reach of a travelling derrick which places the plums in the forms. The contract price of the dam is $120,850.

Investigations of the development of the project showed that a tunnel 5,700 feet long through Lookout Mountain would reduce the length of pipe line eight miles. The north, or entrance portal, was located close to the storage dam. The line of the tunnel is straight, the grade descending from the north to the south portal at the rate of 0.2 per cent. The completed tunnel will be six by six feet in cross section, which size is determined by requirements of construction rather than hydraulic consideration. It is anticipated that rock will be penetrated the entire distance. In the event that faults or pervious material are found it will be necessary to line certain parts of the section.

The work is being prosecuted from both north and south portals simultaneously, both headings penetrating close-grained sandstone. Drilling and mucking operations are identical in both headings. Ingersoll-Rand drills are used at the south and Denver drills at the north portal. Sixty per cent Dupont Gelatin is used, the intensity of loading depending on the nature of the rock. A narrow-gauge track is laid up to the breast of the headings and the muck is removed in half-yard Easton dump cars drawn by mules. One set-up of the drill column is made, from which all holes are drilled except the bottom holes. An average of fifteen holes, from four to six feet in depth, are drilled for each round, and they remove an average of four feet per shot. Differences in the formation or lay of the rock in the north and south headings require changes in the firing order. At the south end, where the rock lies at about thirty degrees from the vertical, inclined toward the south, six to eight cut holes, arranged in two vertical lines at

*City Manager of Staunton, Va.

DAM SITE AND BASIN WHICH WILL BE SUBMERGED.

either side of the center of the breast, are fired, using direct exploders; the side holes next are fired, using first delays, and the remaining holes in the roof and corners follow on second delay exploders. The north end fires four cut holes and one relief hole in the center of the breast, with direct exploders, the rib and top holes with first delays and the bottom with second delays. On this end the rock strata lie horizontal. Direct electric current is used to fire. The rock is sometimes strewn back into the tunnel one-hundred and fifty feet or more, leaving the breast fairly well cleared of muck. Two Rand compressors furnish compressed air at working pressure of one hundred pounds, the air being brought through a three-inch pipe. Two General Electric steam-driven, marine sets furnish 115-volt D. C. current for lighting purposes in the tunnel, the camp buildings and for two No. 6 Type V, American Blower Company's blowers which force fresh air into the advance workings through a sixteen-inch canvas vent tube, delivering 2,000 cubic feet of air at 3,000 feet from the tunnel portal. Drill steel, which is of inch and a quarter size, is sharpened by Rand sharpening machines, eliminating two blacksmiths and four helpers.

The contracts for building the dam and tunnel were awarded to P. G. Ligon of Baltimore, in September, 1924. The time fixed for completion of the work was 365 days and 500 calendar days, respectively. Work in the tunnel is carried on during 24 hours of the day, six days a week.

The cost of the tunnel, using an unlined section through impervious rock, or a timber-lined section through earth or loose rock, is $175,165, based on the contract unit prices and quantities.

It is proposed to lay a twenty-inch concrete pipe from the dam twelve hundred feet to the tunnel portal, and to continue this pipe through the tunnel. This contract is still to be awarded.

The total available head between intake at the dam and outflow at the reservoir in Staunton is 236.5 feet. After providing for aeration and possible filtration, and also head loss through the tunnel, there remains an allowable friction loss per thousand feet of pipe of 2.72 feet. A sixteen-inch pipe line at the end of a life of thirty years, will supply the 1955 estimated requirements of Staunton, or two and one-half million gallons daily, with this friction loss.

PLACING PIPE IN THE TRENCH.

The city therefore purchased from the Lynchburg Foundry Company of Lynchburg, Virginia, approximately fifty-five hundred tons of 16" cast iron pipe.

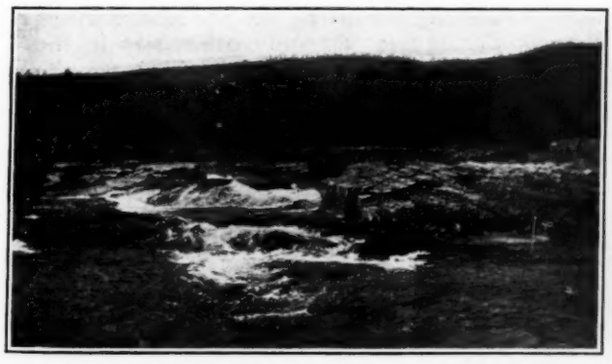
The contract for construction of the pipe line was awarded to the Pace Construction Company of Roanoke, Virginia, in September, 1924, contract time being 365 days.

The city furnishes the pipe f.o.b. cars, and the contractor hauls the pipe to the location, using Mack trucks. An Erie type "A," caterpillar shovel, with half yard dipper, excavates the trench, and averages about five hundred feet per day. Back-filling is done with slip scrapers and teams. Leadite is used in the joints and an average of twenty-five joints, or three hundred feet per day per gang is laid. The trench follows the contours without deep cuts or fills, the typical trench section calling for four feet depth and three feet width. Several streams are to be crossed. The pipe will, in such cases, be encased in concrete well below the bed of the stream.

The contract price for laying the 13.6 miles of pipe is $99,482.

Plans have been prepared for a supplementary reservoir built of reinforced concrete and located two miles west of the city. This reservoir will hold three and one-half million gallons, for use in emergencies, or while repairs are being made to the pipe line. The estimated cost is $35,000. The contract for this reservoir has not yet been awarded.

The City Council has been untiring in its efforts to secure a new water supply, by far the most important project that has been undertaken by the city in recent years, and one that fills its



STREAM FLOWING OVER LEDGE IN BASIN.

OPEN CUT AND SOUTH PORTAL OF TUNNEL.

greatest need. An election, held on February 19, 1924, resulted in a vote of over four to one in favor of issuance of $700,000 bonds.

The bonds, approved by John C. Thomson, Attorney, of New York, were sold to Robert Garrett and Sons of Baltimore, at a premium of $32,557. They bear interest at five per cent. and are of the serial type.

Fuller and McClintock, Engineers, of New York, prepared the plans and specifications, and also have general supervision of construction. Lee H. Williamson was engineer in charge of investigation surveys, and preparation of plans and specifications. Charles H. Chandler is resident engineer in charge of construction. Testing of the cast iron pipe and cement is handled by Conard and Buzby of Burlington, N. J.

Road Maintenance and Traffic

In its annual report for 1924, the State Highway Commission of Maine gives the result of certain census counts taken on the roads of that state and also the cost of maintenance of roads having different kinds of wearing surfaces. Up to 1924 the census counts were confined to one week in each season, but under an arrangement made with the Bureau of Public Roads last year a comprehensive survey was conducted throughout the latter half of the year.

A comparison of traffic counts from 1917 to 1923 shows that the average number of vehicles per day in 1923 was 2¾ times as heavy as in 1917. Moreover, while the 1917 figures apply to main thoroughfares only, the 1923 figures include a number of minor roads.

Even more interesting was the comparison between traffic and maintenance costs on gravel and on bituminous macadam roads. On two gravel roads the average cost of maintenance per mile of road was $759 in one case where the average traffic was 541 vehicles per 12-hour day, and in the case of the other road was $721 per mile with an average traffic count of 594 vehicles per day. Figures are given for three bituminous macadam roads. One of these 14 feet wide with an average of 834 vehicles per day cost $367 per mile per year to maintain; another road 16 feet wide with an average of 2,453 vehicles cost an average of $259 per mile; while the third road, width not stated, with an average traffic of 1,926 vehicles per day, cost $484 per mile. On account of the narrowness of the first road, the cost for maintaining shoulders was excessive. The third road was built with much less foundation than would be used today, which necessitated expensive repairs in 1920 to 1921, the total cost for these two years being $2,242.

The Commission calls attention to the fact that these figures indicate that "traffic is being carried on the bituminous macadam roads at a cost of one-sixth as much per vehicle-mile as is the cost of carrying traffic on the gravel surfaced highways."

One interesting point brought out by the table of costs is that in the case of the bituminous macadam roads the maintenance costs alternate high and low in successive years. This is accounted for by the fact that it is the practice to give bituminous macadam roads a surface of bituminous treatment each alternate year, the maintenance during all the other years consisting only of taking care of the shoulders and possibly making an occasional patch on the surface.

Electricity in Illinois

Data compiled from authoritative sources giving figures as of December, 1924, relative to electric light and power facilities in the state of Illinois bring out several interesting facts. Incidentally, the compilers believe that Illinois has probably the greatest electric light and power facilities per capita of any state in the Union.

Classifying the supply of light and power into two groups, those that are privately-managed businesses and those that are municipally owned and operated, it is found that the municipal plants have 1.4% of the total capacity of all the plants in the state, serve 3.1% of the total number of consumers in the state and generated 1.1% of all the output. The investment reported by the municipalities is only 1% of the total investment in electric facilities for the state, but it is quite probable that many of the municipalities do not have or rigidly follow accounting systems that insure complete accuracy in this respect.

The municipal plants are subdivided into three groups, those which are self-contained, that is, operate a generating plant, maintain a distribution system and conduct the entire business of manufacturing and distributing current; second, those which purchase their electricity at wholesale from private companies and resell it to their residents; and, third, those which maintain generating plants for street lighting but do not supply electricity to residents or industries.

The great difference between the capacities of municipal plants and many of the larger private plants is shown by the striking statement that the total horsepower of all electric light and power plants operated by Illinois municipalities is less than the capacity of any one of twenty turbo-generators operated in the plants of the Commonwealth Edison Company in Chicago. Also, of the seventy cities of the state having the largest population, but one, Peru, has a municipally-owned business which controls the entire electricity facilities for the community; while in Springfield, the only other city in the group which operates an electricity business, the business serves but a portion of the community.

Water Pipe from France

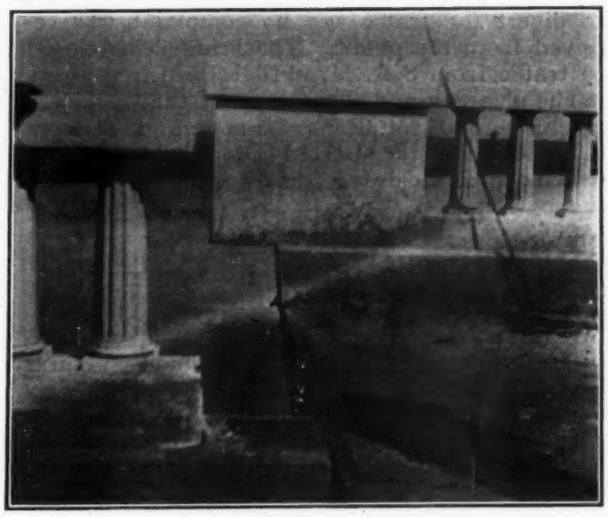
Tacoma, Wash., is reported to have placed an order with a French foundry for about $36,000 worth of cast-iron pipe at a price 5% lower than any made by concerns in the eastern part of the United States. Low freight rates by water through the Panama Canal probably contributed largely to this low price.

A Concrete Lift Span

In constructing the Alamitos Bay Bridge on the Coast Boulevard, Los Angeles County, Calif., the Highway Commission recognized the fact that it might some time be necessary to remove the center span to permit the passage through the bridge of some floating vessel that could not pass under it. Accordingly the center span, 46 feet 6 inches long, was constructed so that it could be removed and replaced if necessary. The bridge is of reinforced concrete 26 feet 10 inches wide.

The removal of the span became necessary some time ago to permit the passage of a large dredge, and was carried out successfully by the Highway Commission at a cost of $500. The tide here has a range of about five feet, and this was utilized in removing the span. A barge 30 feet wide by 104 feet long and 9 feet deep with a draft when unloaded of 2 feet 6 inches was placed under the center of the span at low tide and 12x12 timber docking was placed upon the deck to distribute the load and fill up the space between the deck of the barge and the under side of the span. Seven parallel lines of timbers were used giving 49½ square feet of bearing surface under the five girders with a resulting pressure of 3.4 tons per square foot on the blocking. A measurement of the barge had shown that the theoretical submergence due to the load of 169 tons would be 21 inches.

In constructing this span a space of ¾-inch had been left at each end between this and the adjacent spans, and this had been filled with bituminous expansion joint material. An effort had been made to remove this joint material, two men having worked all the day before with chisel bars without much success, an acetylene blow torch having been used for burning it out with no success whatever, and finally four laborers renewing chiselling, which was continued until lifting began at 8:37 in the morning, at which time about 65% of the jointing material had been removed. The presence of about one-third of the jointing material still remaining caused the span to bind to an extent that caused an actual submergence of the barge of 23 inches,

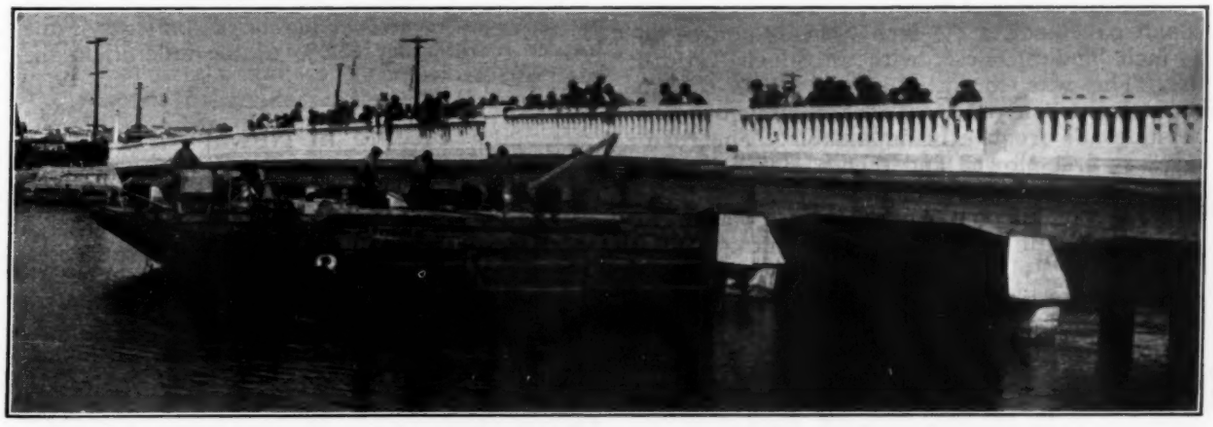


SPAN RETURNING TO POSITION.

or 2 inches more than that calculated as due to the weight of the span, or about 17 tons.

As the barge rose with the tide, the southeast corner of the span rose about 1¼ inches before the southwest corner broke free, which occurred about 9:20. The northwest corner began rising about 9:50 and the northeast corner a few minutes later; and at 10:01 the entire span had been raised sufficiently to permit floating out of position, one end being 7 inches and the other 9 inches above its original position. By shifting a few extra timbers the barge was brought on an even keel and the span floated out with the tidal current aided by a tugboat. Less than ten minutes were consumed in floating out and making fast alongside the bridge. The dredge passed through the span at 11:05 and the span was returned to position for lowering at 11:21, at which time it was 9 inches above its permanent position. As the tide fell the span fell with it and at 1 P. M. it had returned to its seat upon the piers within ⅛-inch of its original position. By 5 P. M. the tide had fallen sufficiently to release the barge.

Wide publicity had been given to the fact that the bridge would be closed to traffic, and four flagmen were stationed at controlling points



SPAN BEING LIFTED BY TIDE—9:53 A. M.

to divert the traffic and no complaint was received from the public. The bridge was closed to traffic from 8 A. M. until 1 P. M.

The planning and supervision of the work was in charge of L. M. Ranson and the actual work was done by the United Dredging Company which owned the dredge that was moved through the passage.

Specifications for Highway Bridges

Standard specifications for steel highway bridges were recommended in December, 1922, by the Sub-Committee on Bridges and Structures of the American Association of State Highway Officials. They were subsequently adopted by the Association by letter-ballot and were later approved by the Secretary of Agriculture for use in connection with federal aid projects and have been published by the U. S. Department of Agriculture, from which copies can be obtained at 10c a copy.

These are complete specifications, 45 pages in length. They are divided into three sections—"Materials," "General Construction" and "Design." Under "Materials" are sections specifying requirements for structural steel for the various parts of the structure, I-bars, steel forgings, steel castings, iron castings etc. Under "General Construction" details are given concerning materials, rivet holes, mill and shop inspection, erection and measurement; also painting at the shop and in the field. Under "Design" the subheadings include: "General Features," "Loads," and "Structural Steel Design."

The committee that recommended these specifications included members of the highway departments of fifteen states, from Maine to Washington and south to Texas.

Varying Paving Costs

An illustration of the variations in cost of paving in the same city but under different conditions has been furnished to us by E. M. Schneck, superintendent of the town of Greenfield, Mass. Mr. Schneck analyzes eight bituminous paving jobs in which the cost per square yard varied from a minimum of 99c to a maximum of $2.50.

The maximum cost was in the case of a sheet asphalt pavement, a 2½-inch wearing course on 2½-inch binder course, with an 8-inch Telford base. This was excavated in bad yellow clay in the spring when the frost was coming out and the subgrade frequently impassable. The roadway was first plowed and then a Haiss digging loader was used, removing the earth to the desired depth in one operation. The clay was excavated to a width of 21 feet and an average depth of 16 inches. Following this a sub-foundation of 4 inches of gravel was spread, followed by the 8-inch Telford base. Mr. Schneck considers that the use of the digging loader and the fact that the local hard red sandstone used for the Telford base had to be hauled only 1 mile permitted doing the work at a very reasonable figure.

Another job practically the same as the one just described was, however, completed at $1.88 per square yard, "the considerably decreased cost being due to the fact that we purchased the stone for the Telford base at a price considerably less than it would have cost us to quarry the same; also the excavated material being used for filling on another job for which we had an appropriation, we were able to charge against the second job an amount equal to about 35c per cubic yard of material."

The minimum cost of 99c was on a job consisting of straight 2½-inch binder course with a 2½-inch wearing course placed on an existing Telford foundation. Another road costing $2.12 was a 5-inch bituminous top placed on an existing macadam road but one on which it was necessary to place from 3 to 5 inches of stone fill to build it up to a new grade. In another instance the square yard cost was increased by the fact that out of a total of $8,200, about $2,000 was for constructing a storm sewer and catch-basins.

Use of Standard Paving Brick

It will be remembered that the National Paving Brick Manufacturers Association, cooperating with Secretary Hoover and with engineers and others interested in the subject, decided some months ago to adopt five varieties of brick as recognized standards, with the hope that ultimately practically all of the brick output would be confined to these five. An inspection of the report of the brick manufacturers association for January shows that this end has not yet been reached, although the distance remaining to go is not very great.

At the end of that month the total unfilled orders on hand amounted to 55,810 thousands of No. 1 brick, and of these 27% were of special and eliminated varieties and types. (In addition to the five recognized varieties, hillside bricks were also recognized as a special variety for which there might be more or less legitimate demand.) Of the five recognized varieties three might almost be eliminated, to judge by the amounts recently ordered. Dunn wire-cut lug bricks 4x3½x8½ constituted only 1.5% and the same type of brick 3x3½x8½ only 1.4% of the orders. Also the 3½x4x8½ vertical fibre lugless bricks constituted only 3.3%. All the remaining orders were divided between vertical fibre lugless 3x4x8½, and repressed lug brick 4x3½x8½, the former representing 46.8% of the orders and the latter 20.0%.

Paving in Newark

During 1924 approximately 11 miles of street paving was laid in Newark, N. J., according to the report of George W. Andress, engineer in charge of the Bureau of Streets. This is about three-fourths as much as was done in 1923.

The average costs per square yard for the different types of paving were: $3.257 for asphalt on new concrete, $1.872 for resurfacing with asphalt over Telford, and 97c. for resurfacing with asphalt by the burner method. Of the total amount laid, about 139,000 square yards was asphalt on new concrete,

55,600 was asphalt resurfacing over old Telford, 3,790 was asphalt resurfacing by the burner method, and 17,830 was reclipped granite block.

Motor Vehicle Accidents

Study of accidents in Montana, Oregon and Washington. Relation to number registered and volume of traffic. Nature, location and cause of accidents

A study has been made of motor vehicle accidents in the states of Montana, Oregon and Washington by A. C. Rose, associate highway engineer with the United States Bureau of Public Roads. The author has compiled his figures from newspaper reports of accidents in those states during the period from December, 1923 to September, 1924. Some of the figures and conclusions given by Mr. Rose in his report, which has recently been made public by the Bureau of Public Roads, are given in the paragraphs below.

The total vehicle registration in Montana last year was 69,100, in Oregon 161,739 and in Washington 265,541. Using these figures and the newspaper reports of accidents shows 1.95 accidents per thousand vehicles in Montana, 2.84 in Oregon and 3.82 in Washington. The fact that the greatest number of accidents per thousand vehicles is found in the state with the largest vehicle registration is directly contrary to the annual statistics of such accidents the nation over, which show that the rate of accidents is decreasing as the number of vehicles increases. Mr. Rose suggests that the latter is due to the increasing familiarity with motor vehicles, to better traffic regulations, increased caution, and improvements in the design of vehicles and of highways.

Another peculiarity of these figures is that while in Montana the ratio of fatalities to accidents is 24.4%, in Oregon it is only 12.2% and in Washington 10.3%. On the other hand, in Montana the ratio of vehicles damaged to accidents is 76.2%, in Oregon 84.1% and in Washington 92.1%. Just why the Montana accidents seem to be so much more severe on humans and less severe on the automobiles is not apparent from any information given.

Several of the figures seem to indicate that the number of accidents depends largely upon the volume of traffic on the roads. Washington, with about twice as many accidents per thousand vehicles, has five times as many licensed vehicles per mile of road as has Montana; while in Oregon, which has a percentage of accidents about the mean of the other two states, the number of vehicles per mile of road also is a mean between the other two. Another indication of the same relation is that the greatest number of accidents occur during the months of July, August and September when the traffic is heaviest. Again, the greatest number of accidents are found to occur on paved roads, being 2½ times as great as those occurring on gravel, macadam and earth roads where the traffic undoubtedly is not so dense.

Compared in another way, the figures show 52.4% of the accidents occurring by daylight and 38.4% during darkness, with 9.2% unknown. This presumably does not indicate that the risk is greater during daylight. Traffic counts made in Oregon during May showed about 3½ times as much traffic during daylight as during darkness, and if this ratio be applied to the other, we apparently have a risk about 2¾ times as great in dark as in daytime. The fact that more accidents occur in summer than in winter should probably be subjected to a similar modification. The amount of traffic in July, according to certain other traffic surveys, is about 2½ times that in December, and applying this relation to the ratio of summer to winter accidents would indicate that the latter period was really the more dangerous to such automobiles as were using the roads.

Analyzing the statistics to determine the nature of the accidents, Mr. Rose finds that in 47.6% the motor vehicle left the road, in 33.4% there was a collision between two motor vehicles, in 7.9% an equestrian or pedestrian was run down, in 3.9% there was a collision between a motor vehicle and a train, in 1.4% a collision of a motor vehicle with some other vehicle, and 3.8% were miscellaneous or unknown. It is quite possible that in some of the accidents in which the motor vehicle left the road it did so to avoid collision with another vehicle. Probably the majority of such instances, however, could be attributed to reckless driving, inexperience, intoxication, etc.

Information as to the location of the accident was available in only 40.2% of the accidents. Comparing those of which this information was known, we find 26% of them were on curves, 22% on grades, 20% on straight-away, 13% at intersection of highways, 11% at railroad grade crossings and 8% on bridges. Similar statistics from other states have shown the greatest number of accidents on long level tangents, which encourage excessive speed and diminish caution. For instance, a survey made of accidents in Wisconsin showed 68.6% on straight roads, 16% at curves and corners and 1.2% on hills. The fact that exactly the reverse is true in these states may probably be due to the mountainous character of the country which makes curves and grades a common feature of the highways.

A summary of the causes of the accidents shows that about 64% were due to faulty operation by the driver, 12% to faults of others than the drivers, 11% to faulty equipment and 13% to faulty highway conditions. The last is that in which engineers are most interested, and we find that of accidents due to such conditions 70% are attributed to skidding surface, 7% to narrow highways, 5% to unnecessary obstruction of view, 2½% to narrow bridges or culverts, 2½% to holes or depressions in the highway and the balance to lack of sight distance,

inadequate signs, lack of guard rail (there being one accident for each of these) and 25 miscellaneous causes.

Concerning the matter of skidding, the author says that an attempt was made to determine whether cement concrete or bituminous pavements were the more dangerous, but this was abandoned because of lack of sufficient data to support any positive conclusion. The number of accidents per mile of pavement of each type seemed to be practically the same.

What might be construed as a miscarriage of justice is found by comparing the ratio of fatal and non-fatal injuries to the number of accidents in each of the several states, with the responsibilities of the driver for the accidents. In Montana where the ratio of fatalities to accidents is 2½ times as great as in Washington and the ratio of persons injured to accidents 20% greater, the accidents were due to the driver in only three-fourths as many cases. On the other hand, the accident is attributed to faulty equipment in more than twice as high a percentage of cases in Montana as in Washington. It might be inferred, whether correctly or not, that accidents due to faulty equipment are more likely to seriously injure the occupants of the car than are those due to the fault of the driver.

Mr. Rose concludes his analysis by stating that the statistics presented clearly indicate that the greater risk exists on crowded highways, and that it, therefore, follows that on such highways there is need of greater care in operation and the adoption of whatever measures may lend themselves to the reduction of the seriousness of unavoidable accidents. He believes that the reduction of speed on congested roads will go far to prevent the occurrence of the more serious accidents. Reduction of congestion by providing more extensive highway facilities is becoming vitally necessary. "The part the highway engineer may play in this solution is illustrated by the proposed grade separation and superhighway now planned from Detroit to Pontiac, Mich. The Washington State Highway Department is also preparing to reduce the traffic density between Seattle and Tacoma by the construction of two 18-foot parallel pavements separated by a parking space, all built over an entirely new route. Each side of the road will be used by traffic moving in one direction only."

"It is believed that the establishment of speed zones, in each of which the maximum speed limit will be determined by the congestion of traffic in the zone, will in some measure provide an immediate remedy. Such a plan is now in effect in Maryland, apparently with favorable results."

Michigan Highway Markers

Part of the unused war material distributed by the United States consisted of thousands of angle iron posts slotted for use with barbed wire fencing. The highway commissioners of Michigan obtained a number of these and are now using them for supporting highway markers. Two of the angle irons are bolted together and driven into the ground to form the post and to these is fastened a target giving the number of the highway and other information.

Refinements in Concrete Pavement Construction

An outstanding feature of concrete pavement construction during 1924, according to the Portland Cement Association, was the emphasis placed on the need for securing better surfaces. At least thirty-five states provided in their 1924 specifications that the maximum variation allowed from a true surface was limited to ¼-inch in distances varying from 3 feet to 10 feet; one state limiting the allowance to 1/16-inch per foot. The use of a longitudinal float was required by eight states and such float has also come into extensive use in city pavement construction.

Metropolitan Districts

Some details concerning fourteen districts, collected by Detroit Bureau of Governmental Research. Desirability of such districts

There is under consideration the establishing in south-eastern Michigan of one or more metropolitan districts, and in connection with this the Detroit Bureau of Governmental Research has investigated and reported upon metropolitan districts or areas already in operation and the government of them. There is already a considerable number of such districts, some of sufficiently long life to afford valuable information as to the best methods of government and the advantages and disadvantages.

The districts considered by the Bureau were as follows: Miami Conservancy District, Ohio; Metropolitan District Commission of Massachusetts; Essex Border Utilities Commission, Ontario; Sanitary District of Chicago; Passaic Valley Sewerage Commission, New Jersey; Greater Winnipeg Water District, Manitoba; Washington Suburban Sanitary District, Maryland; South Park Commission, Illinois; East Bay Municipal Utility District, California; State of Rhode Island Metropolitan Park Commission; Montreal Metropolitan Commission; Los Angeles Sanitary District; Port of New York Authority; London, England, Metropolitan Districts. There are a number of other metropolitan districts in the United States, such districts being common for the purpose of securing park development and carrying on drainage projects. Other bodies, such as the Hudson County Parks Commission and the New Orleans Water and Sewerage Board, lack certain essen-

tial characteristics of true metropolitan districts.

The desirability and even necessity for such districts was referred to by Prof. Chester C. Maxey in the National Municipal Review for August, 1922, from which the following sentences are quoted: "The city as a political entity is not identical with the metropolitan community as a social and economic fact; and so, like a house divided against itself, the metropolitan district finds itself obliged to struggle for civil achievement amid the conflicts, dissensions and divergences of its several component political jurisdictions. . . . The great problems which demand governmental action in metropolitan communities—public health, recreation, public utilities, crime and the like—hold political boundaries in contempt. And the only effect of multiplying political jurisdiction for dealing with such problems is to obstruct and defeat the primary purposes for which local government exists."

In a report on the proposed Detroit metropolitan area in 1924, the Detroit Bureau stated: "There is immediate need for the unification of authority within the metropolitan area of Detroit to deal with the questions of water supply, sewerage, rapid transit, and port development." Officers of the Michigan Metropolitan Conference, consisting of official representatives of nine counties interested, were reported to be drafting a constitutional amendment to be presented to the conference. Should this amendment be adopted, a metropolitan district would probably be created by the approval of a charter outlining the form of government, which charter would be voted upon separately by each city, village and township within the proposed district, each of which should have representation on the governing body of the district. The administration of the several activities of the district would be delegated to separate commissions responsible to the legislative body of the district, thus eliminating the necessity of more than one district.

The report of the Bureau gives briefly the chief points of interest concerning the several districts named, which may be still further abridged and summarized as follows:

Miami Conservancy District.—Created by the Ohio Legislature in 1914 without referendum. For the construction and maintenance of dams and channels for flood control. It contains 3,700 square miles lying in nine counties. It is governed by three directors appointed by a conservancy court. Revenues are raised by special assessment on all property benefited.

Metropolitan District Commission of Massachusetts. The consolidation of several commissions which were created, that for sewerage in 1889, for parks in 1893, for water supply in 1895 and for planning in 1923, all without referendum. The Commission controls these various public utilities, the sewerage within an area of 211 square miles containing twenty-seven municipalities; the water within an area of 167 square miles containing nineteen municipalities. Five commissioners are appointed by the Governor. Expenses are met by appropriations from the state budget collected by the state by taxation upon the property involved.

Essex Border Utilities Commission. Created by special act and incorporated in 1916 without referendum. Has charge of water supply, sewer facilities, hospitals, health, parks and city planning in an area of 42 square miles including eight municipalities. Governed by nineteen commissioners, eleven elected by the eight municipalities and the other eight the mayors of these municipalities. Expenses of improvements are met by bonds which are carried by assessments in proportion to benefits derived.

Sanitary District of Chicago. Created by legislative act in 1889 with referendum. For constructing and maintaining a sewerage system, functioning within an area of 436 square miles including Chicago and forty-nine other municipalities. Nine trustees are elected by the voters of the district. Expenses are financed by taxation.

Passaic Valley Sewerage Commission. Created by state legislature in 1907 and later amendments, without referendum. To construct, maintain and operate sewers and sewage treatment plants and secure the purification of the Passaic river within a district containing 80 square miles and including twenty-two municipalities. There are five commissioners appointed by the governor. Construction expenses are levied on the different municipalities on the basis of assessed value and operating expenses on the basis of sewage delivered.

Greater Winnipeg Water District. Created by the Provincial Legislature in 1913, without referendum except Winnipeg. To construct and operate facilities necessary for water supply over an area of 52 square miles which includes the city of Winnipeg and eight other municipalities. Governed by an administrative board of fourteen members, one for each municipality, Winnipeg having five members on the board and St. Boniface two. Expenses are all derived from receipts from the sale of water.

Washington Suburban Sanitary District. Created by the Maryland Legislature in 1918 without referendum. To construct, maintain and operate water and sewerage systems and supervise street layout and platting over an area of 95 square miles immediately adjacent to Washington, D. C. Governed by three commissioners, one appointed by the commission of each of the two counties in which the district lies and one by the governor of the state. Permanent improvements are provided for partly by special assessments based upon benefits and partly by a general tax, while operating expenses are met by charges for services.

South Park Commission. Created by Illinois Legislature in 1869 without referendum. To acquire and maintain public parks and boulevards over an area of 95 square miles including parts of Chicago and Cook County. Governed by five commissioners appointed by the judges of the Circuit Court of Cook County. Expenses met by

tax levy upon the property within the district.

East Bay Municipal Utility District. Created by California Legislature in 1921 with referendum. To have entire charge of providing an adequate water supply to nine cities and villages including Oakland, with a total population of about 600,000. Governed by five commissioners elected by the district. Expenses are furnished through the county budget.

Rhode Island Metropolitan Park Commission. Created by General Assembly in 1904 without referendum. To acquire and maintain parks in an area of 176 square miles including Providence and ten other municipalities. The park area now totals 1,211 acres. Governed by five commissioners appointed by the governor. Financed by bond issues and annual state appropriations, with original intention (never carried out) of apportioning the cost among the cities and villages on the basis of population and valuation.

Montreal Metropolitan Commission. Created by Provincial Legislature without referendum. To control loans and exercise borrowing power for all municipalities except Montreal contained in an area of 95 square miles including sixteen municipalities; also supervision of the administration of subventions extended to four municipalities and financing the capital expenditure of these. Governed by fifteen commissioners appointed by the municipalities. Expenses financed by taxes upon the assessable property of the municipalities.

Los Angeles Sanitary District. Created by State Legislature without referendum. To conduct a sewerage survey and construct and maintain a sewerage system for an area comprising approximately three-quarters of Los Angeles County containing about twenty municipalities. Governed by the Board of Supervisors of the county as a legislative body, with administrative direction vested in a board consisting of one member from the governing body of each of the two principal cities and the chairman of the board of supervisors. Surveys financed by county appropriations; construction and maintenance costs by assessments on property benefited.

Port of New York Authority. Created by treaty between the states of New York and New Jersey in 1921, pursuant to statutes passed by the legislatures of the two states, and ratified by resolution of Congress. To prepare a comprehensive plan of port development, coordinate port facilities, own and operate terminal and transportation facilities, etc. The area involved is nearly 1,500 square miles embracing all the industrial territory of Hoboken, Jersey City, Newark, New York City—a total of 105 municipalities with a population of 8,000,000 and having 771 miles of waterfront. Governed by six commissioners, three appointed from each state. Current expenses are met by state appropriations; improvements by the transportation companies involved and by the sale of securities based upon the value of the improvements made.

London Metropolitan Districts. The Metropolitan Districts of London, England, began with the creation of a metropolitan board of works in 1885, chiefly for drainage. Since then there have been created the Metropolitan Commission of Sewers serving a population of 6,000,000; Metropolitan Board of Parks, Metropolitan Police District, Metropolitan Water District and London Electricity Supply Area. The Water District is composed of London and five surrounding counties with a population of 8,000,000 to 9,000,000.

Cleaning Chicago Catchbasins

As in previous years, the city of Chicago cleaned its catchbasins by both hand and machine during the year 1923 (the report for which year was recently distributed), 19,195 having been cleaned by hand and 32,745 by machine. The cost or hand cleaning was $71,784, or an average cost of $3.74 per basin cleaned. The cost of cleaning by machine was $66,314, or an average of $2.03 per basin cleaned. This latter cost included $52,267 for wages, $4,001 for repairs and $5,329 for supplies, while $4,714 was allowed for interest at 4% and the depreciation at 10 cents per mile traveled.

The total number of catchbasins in the city at the end of the year was 135,916 and at the beginning of the year 132,088. The average being about 134,000, it appears that if no basin was cleaned more than once, less than 40% of them were cleaned at all. It seems probable that some basins required cleaning several times during the year and that consequently fully three-fourths of them received no attention of this kind whatsoever. In other words, the catchbasin part of over 100,000 inlets served no useful purpose whatever and the money employed in constructing them was wasted.

Electrification of Dayton Waterworks

It is proposed to electrify the waterworks of the city of Dayton, Ohio, in the near future, the development of the scheme having reached the point where the Dayton Power and Light Company has agreed to furnish electric current for operating the pumping plant for a period of ten years at a rate which, the city officials calculate, will mean a saving in operating cost of not less than $23,000 a year.

The capacity of the present plant has practically been reached, and this and its age demand that replacements, rearrangements or additions of new power and pumping units be installed within the next one or two years. It has been calculated that it would be more economical to equip the station with electric machinery than to replace the steam plant and increase the building capacity of the house for same. A new power plant electrically driven can be installed without interruption of service and without reconstruction of the building and at a cost one-third as great as that of new steam pumping units of the same capacity. It is estimated that this saving will amount to at least $400,000.

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Taxing Municipally Owned Properties

As a general rule, it is considered illogical to tax municipally owned properties, but this applies to properties lying within the boundary of the municipality which owns them. Where property owned by one municipality lies within the boundaries of another municipality there would seem to be, in some cases, excellent reasons why this property should be taxed like any other. An interesting case in point is that of the land occupied by the Wanaque dam and reservoir, all of which lies in boroughs and townships which do not use it in connection with their water supply. Wanaque borough is appealing to the New Jersey State Legislature for permission to assess that portion of the land occupied by the Wanaque dam and reservoir which lies within its limits, stating that the borough's only industrial plant, a paper mill, was razed to make way for the dam and that more than a half of the taxable property of the borough was taken out of the rateables by the law which prohibits taxing municipal property devoted to public use. The cost of maintaining the highways within the borough will probably be even greater rather than less because of the reservoir, while the other expenses of maintaining schools, street lighting, etc., will not be diminished. Under these conditions the borough finds itself confronted with a serious proposition as to how it can obtain the funds for carrying on even the most essential of its functions.

While this is perhaps an extreme case, it presents a principle that is to be found in many other localities where waterworks, sewage treatment plants and other municipal properties devoted to public use are located in adjacent or nearby towns or districts.

Accident Statistics

Statistics, in themselves absolutely reliable, may be used as arguments for supporting statements that are absolutely false. An illustration is offered by the anecdote of a steel worker who said that statistics proved that a bed was a much more dangerous place than the top of a steel building under erection since the great majority of deaths in this country occurred in beds.

In a study of motor vehicle accidents abstracted in this issue a great many details are given concerning accidents which have occurred in three western states. The author has been careful to call attention to the misuse which may be made of these figures, but the matter should be thoroughly appreciated as it is possible that improper use may be made of such figures for commercial purposes. For instance, more than 75% of the accidents occurred on paved roads as compared to gravel, macadam and earth roads. This does not mean that a paved road is in itself inherently more dangerous, but that such roads are almost invariably more crowded than unpaved ones, and it is the crowd rather than the paving which causes the accidents.

Another comparison shows that nearly 40% more accidents occur in daylight than in darkness. Traffic, however, is generally several times as great in the daytime as at night and consequently the chances of accident in proportion to the number traveling is greater at night. Another illustration is found in the location of the accidents. Twenty-six percent of those referred to in this article occurred on curves and 22% on grades. This would seem to be exactly contrary to the experience in other states, where the majority of accidents occur on long, level tangents. The answer is that in the three states involved in this study—Montana, Washington and Oregon—the majority of roads are in mountainous country where curves and grades predominate. The figures would appear to be especially severe on asphaltic surfaces, since 75% of the accidents that were attributed to highway conditions were due to skiddy surface. If statistics of the state, however, showed that 75% of the paved surfaces of the state were asphalt, this figure would lose such significance.

The above is not intended to imply that statistics of this kind are valueless or worse, but that they should be used only with the greatest of discretion and that conclusions cannot safely be drawn from them except by those who have familiarized themselves with all of the conditions bearing upon the problem.

One conclusion that does seem to be legitimate, assuming the original reports were correct, is the relative responsibility for the accident of the driver of the damaged car, the driver of other cars, faulty equipment and faulty highway conditions. These seem to indicate that in these three states only 13% of the accidents are attributable to the highway conditions, while 60% are due to faulty operation of the car to which the accident happened, 12% to the drivers of other cars and 11% to faulty equipment of the cars. It is comforting to highway engineers to know that such a small percent of the accidents can be laid at their door, but they should not on this account diminish their efforts towards still further reducing this percentage. The faulty highway conditions considered to be responsible for accidents are discussed more at length in the article referred to.

Reinforced Concrete Pavement Survey

We noted a month or two ago that the Highway Research Board is conducting a survey for determining the economic value of steel reinforcement in concrete pavements. The latest information made public shows that considerable progress is being made. The roads to be studied have been selected and final road inspections are now in progress and will probably continue throughout the summer. Analyses of subgrade samples taken in connection with the investigation are being made by the U. S. Bureau of Public Roads, and the University of Maryland is cooperating in the examination of cores for determining the effect of time and cracks on reinforcement, while various state highway departments have offered cooperation in the making of the inspections and core drill work for checking location of steel and thickness of slab.

As this is a study of roads that have already been constructed and in service, it was found to be quite difficult to obtain just what was desired for comparative study. After considerable investigation the board has located 188 highways whose surfaces contain both plain and reinforced concrete sections which were built at the same time, by the same contractor, under the same supervision and from the same materials and have been subjected to the same traffic and climatic conditions. It is believed, therefore, that in the roads being studied all undesirable variables are eliminated except those of subgrade and strength of concrete. These highways are distributed through thirty states extending from Connecticut to California and from Minnesota to Texas, with one in Ontario, Canada. Various soil conditions are found as well as wide variations in freezing and other climatic conditions, and age, mix, intensity of traffic and cross-section vary within wide limits. In the reinforcement are included different weights of mesh and various designs of bars.

Garbage Disposal in Chicago

Figures of the Bureau of Waste Disposal of the city of Chicago for the year 1923, contained in the annual report which was published a few weeks ago, show that during that year there were received at the garbage reduction plant 105,226 tons of garbage, an increase of 1.11% over the total of the year previous. From this there was obtained 5,724,000 pounds of garbage grease, which was 42% greater than during any previous year. The tankage totalled 8,655 tons, which was about 15% more than the year previous.

The amount received as revenue of the plant was as follows: For garbage grease, $232,839; for garbage tankage, $42,776; for garbage bones, $588; for garbage rags, $220; for scrap iron, $628; for miscellaneous materials, $18; a total of $277,069. The amount of garbage bones recovered was 29.4 tons, of garbage rags 109.9 tons and of scrap iron and other materials 139.6 tons.

As against this total revenue of $277,069, the operating expenditures were $712,219, showing an operating loss of more than $435,000. The operating expenditures consisted of the following items: Salaries and wages, $421,683; fuel oil, $73,630; power, $16,348; light, $1,755; coal, $49,333; supplies and repairs, $126,441; removal of dried garbage and rubbish, $23,028.

This gives a total cost of operation per ton of raw garbage of $6.77. In addition to this cost of treatment, the cost of collection was $5.92 per ton. Part of the garbage was carried to the plant by direct haul and part by boat, the boat hire comprising a little over 10% of the total cost.

During the year $33,000 was spent in new construction, comprising an additional storage tank, three additional condensers, an additional pulverizer and a steam fire pump.

Says Eugene Vollmer, general foreman in charge of waste disposal: "The reduction plant has been operated as efficiently and economically as possible consistent with the sanitary disposal of the city's garbage. The organization of the plant, consisting of an average of 240 employees throughout the year, made it possible to dispose of the garbage with very little overtime, and we closed the plant for 28 days, in addition to Sundays and holidays, when the receipts were insufficient for full-time operation."

Assessing for "Stage" Construction

As in the case with many other state highway departments, that of Maine systematically carries on a program of road construction by what has been termed the "stage" method, the development from a dirt road to one of high-grade hard surface being made in two or more stages, a gravel or other cheap road constituting the first stage.

The matter of assessing the cost of such construction is discussed by the State Highway Commission in its report for 1924 as follows:

"The question as to how the cost of such construction should be borne naturally arises. If capital resources were ample, the cost of strengthening and building a higher type of pavement on an old roadbed might properly be charged to the capital account, as the work would undoubtedly be of an entirely different type and much superior to the original construction, which had become worn out and obsolete.

"On the other hand, it may not be unreasonable or unfair to charge the cost of resurfacing worn out roads with a higher type of construction against maintenance and reconstruction funds (current revenues), on the ground that the traffic which wears out the road should bear the cost of replacing the same. It is believed that this is the view most generally taken by the various states of the Union and that these charges are generally so met.

"The main point to be kept in mind at the present moment is that funds must be found from some source to protect the State's investment so far made and to bring many of the older roads up to a strength sufficient to accommodate present day traffic."

Washington Motor Vehicle Licenses

The state of Washington is finding the collections from motor vehicle licenses to be greater than had been anticipated and in consequence hopes to be able to increase the mileage of roads built this year beyond previous expectations. James Allen, state highway engineer, has been informed by State Treasurer Potts that on Jan. 31st the motor vehicle license collections amounted to $3,201,772 as compared to $2,716,275 on January 31st, 1924.

Locomotive Smoke Destroys Concrete

The Fallsway viaduct in Baltimore, Md., was built in 1913-14 under the supervision of the Sewerage Commission. It consists of a series of reinforced concrete ribbed arches on which rest concrete girders which carry a concrete floor slab. At one point four 64-foot skew spans carry the viaduct over the tracks of the Pennsylvania Railroad. One of these tracks leads into the freight yard with an upgrade. Due to the excessive amount of gases and exhaust blast from the engines in pulling heavy trains on this upgrade and to the large amount of shifting, the concrete over this track was especially subjected to the engine smoke and has become seriously injured. Last summer a scaffold was built under this arch and the space between it and the arch was enclosed to protect from the engine smoke the men working thereon, and the condition of the arch was thoroughly examined.

It was found that the skew concrete ribs and floor beams were seriously damaged, the concrete being eaten away to as much as 5 inches in depth and the reinforcing steel being exposed in a number of places. It was decided to restore the concrete by the use of the cement gun, first cleaning the soot from the surface and removing all loose concrete.

When the work of removing the loose concrete was started, large pieces of concrete broke away from the ribs and beams, exposing the steel, while the concrete crumbled to pieces. As this was a much more serious condition than was at first anticipated, a more thorough inspection was made in order to determine if the structure should be repaired or whether it would be necessary to rebuild the entire span.

It was found, however, after breaking off all the loose disintegrated concrete, that the rest of the concrete was firm and of fairly good mix, and the cement gun repairing was carried on.

In performing this work about 2,000 half-inch holes were drilled into the concrete with a pneumatic hammer and ⅜-inch expansion bolts placed in them. Three-eighth-inch round steel rods were then wired to the expansion bolts and the entire surface to be repaired was covered with No. 9 electric welded wire of 2x2 mesh, fastened securely to the rods.

A section of the surface of the concrete was then cleaned by sand blast and the cement gun used to apply a mixture of one part cement and two parts sand, with a small portion of King-Windsor plaster added to aid cohesion of the mortar until the setting of the cement took place.

The materials were sieved and mixed dry and fed into the cement gun, where air pressure forced the mixture through rubber hose to a nozzle, where water was added. The mortar was shot onto the surface of the old concrete until a depth of from 1½ inches to 5 inches had been applied. The cement used amounted to 887 bags.

The work was begun on August 2nd, 1924 and completed on November 15th. The total cost was $5,064 for labor and $3,029 for material.

Snow Removal in Massachusetts

Revised methods of State Highway Department, utilizing city and town facilities, prove successful

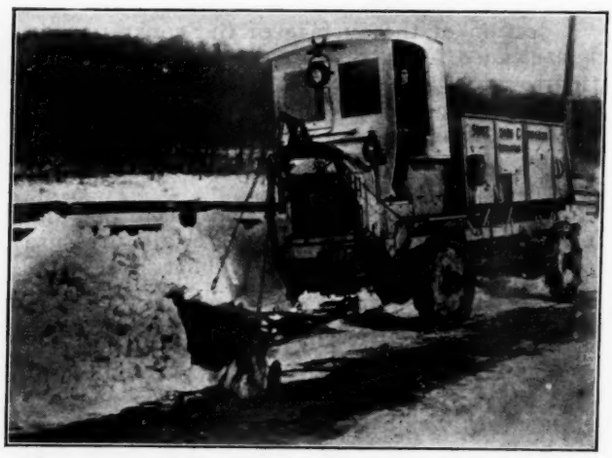
The snow storm which occurred on January 21st offered a good opportunity for testing the snow removal system of the Massachusetts highway department and the cities and towns that co-operated with it. The system was originated in the fall of 1923 and modified after the experience of the winter of 1923-24.

One fact demonstrated by experience of last winter is the efficiency with which the work has been done in co-operation with the cities and towns. Another is the cheapness of the operation, indicating that future snow removal can be undertaken upon an even more comprehensive scale without danger of bankrupting the state or the municipalities.

The original plan which was adopted about two years ago was that the state highway division was to keep clear two important routes, it being understood that half the cost would be assessed back upon the towns. The highway division also was to provide trucks, plows and tractors to the municipalities which would operate them under the supervision of highway division engineers.

All routes planned to be kept open were successfully opened and kept open throughout the winter of 1923-24. The most exacting test during that season was the March blizzard of 1924. At that time those in charge of snow removal had begun to feel that winter was over, and when the heavy snow descended and then froze, the weather was a little too quick for the workers so that in places there were temporary blocks. This was due to the fact that the vital principle of snow removal—to begin with the storm and keep at it until the snow ends—was ignored.

For the most part the snow removal was accomplished most successfully in 1923-24 by trucks equipped with blade plows. The state had 50 former army trucks and about 10 tractors which were distributed to strategical points throughout the state. The other equipment consists of two hundred plows which were loaned to cities and towns that supplied their own motive power in the form of trucks. In addition, some of the counties did much work with their own equipment. Generally speaking, the trucks with a plow in front have proved to be the most useful piece of machinery for combating snow where it is not too heavy. Where the snow is heavy and deep the tractor is necessary and the deeper the snow the more powerful the tractor required.



PLOWING SNOW ON MASSACHUSETTS ROADS.

The state's work on the two main routes kept open was done at remarkably low expense, having cost up to the time of the March blizzard only about $20 a mile on one route and $30 on another.

The experience of 1923-1924 taught that the snow should be plowed close to the surface of the road. Also that the traffic on the road determines to a considerable extent the cost of snow removal. Another result that seems fairly apparent is that it is unjust to expect the small towns having a large mileage of state road to do a very large share of the work at their own expense.

In some parts of the state objections to removing all the snow have been raised by farmers and others who wished to use sleds upon the state roads. But these complaints have to be ignored, for it has been found that if even a few inches of snow are left, ruts develop which make driving dangerous for all sorts of vehicles and which tend to unduly wear out the roads. Whether the roads as a whole benefit from complete removal of the snow is a problem on which authorities are not agreed. Some claim that with the snow removed, the wear of the traffic is evenly distributed. To which the answer is made that with a blanket of snow and ice there is no wear on the road surface. And the proponent of complete removal comes back with the statement that with a coat left, ruts develop which are dangerous to traffic and which permit a pounding on the road in one line so that holes are developed.

The first real test of the system came in January 21st, 1925. Following the heavy snow storm of that morning, which covered all of Massachusetts and accumulated to the depth of eight to twelve inches, the main routes were cleaned so effectively that by the following morning it was possible to travel the length and breadth of the state over plowed roads. In fact, practically all the main lines were open by 10:30 Tuesday night, about two and one-half hours after the storm ended.

It is estimated that over four hundred road snow plows were combating the storm. These included the state owned trucks and plows, most of them loaned to cities and towns for snow work; the Federal-owned trucks, loaned to the state and in turn loaned by the state to the municipalities; and trucks and plows owned by cities and towns and by counties. The trucks and plows did such effective work in bucking the snow that it was unnecessary to call out the state's big tractors, which are considered the heavy artillery of the snow fighting force.

The reason for this success was that almost without exception those charged with doing the plowing obeyed the instructions given by Major Crafts and began to plow as soon as the snow began to fall and kept it up until the storm ended. The commission carried out its plan of giving radio warning and Tuesday morning broadcast information that the storm was likely to be a heavy one. But even before that bulletin was sent out through several broadcasting stations, snow fighters were at work all over the state. They devoted their attention primarily to keeping the main roads from becoming blocked with snow and the commission heard of only one place on a through route where vehicles were unable to pass all night Tuesday.

In loaning 225 plows and 87 trucks to communities along the main thoroughfares, the department stipulated that they were to be used first to remove the snow from the through routes. Afterwards, if the communities desired to do so, the machinery could be used on city and town streets and roads. The tractors were kept in control of the state for use in any section where the snow became too deep to be handled by the plows, but in the recent storm the tractors were not needed. In addition to the state apparatus, a great many municipalities since last year have purchased snow-fighting apparatus and these municipally-owned plows and trucks served to augment the state fleet.

New Jersey Sewage Disposal Studies

Result of a year's investigation of chemical and bacteriological conditions in Imhoff tanks, fauna of tanks and sprinkling beds, fungi and algae in filter beds, film removal and other phenomena

Several articles have appeared in PUBLIC WORKS from time to time during the past two or three years describing certain phases of studies on the biology of sewage disposal being made jointly by the Agricultural Experiment Stations and the State Department of Health of New Jersey. As the investigators say in the introduction to their 1924 report:

"So long as the interdependence of bacteria, protoza, microscopic plants and their resulting chemical changes are not correlated, no true picture can be constructed of the activities taking place during the processes of digestion, stabilization or so-called purification of sewage. At present there are only scattered observations on the plants and animals concerned. Only a beginning has been made in the enumeration of species and their seasonal variation. Almost nothing is known about their food intake and excretion products. The possible physico-chemical factors involved in sedimentation and digestion processes are mainly a controversy. Very little is known concerning the effects of organic acids, produced during the processes of digestion, upon the flora and fauna. Criticism of our present knowledge could easily be extended but these examples suffice to show the importance of correlative investigations.

"The studies presented were pursued with the intent of correlating various phases of investigation. At the same time the sewage substation has made an effort to start cooperative experiments with sewage disposal plants in different parts of the country in an effort to widen the interpretation of findings here and elsewhere. In a former publication it was pointed out that 'since the pH values of the material in the tanks seem to indicate in a general way the changes occurring during the process of digestion, it may be possible that the determination of hydrogen-ion concentration can be used as a simple measurement for the course digestion is taking in a particular tank or plant.' Investigations along this line are being cooperated in by superintendents and chemists of eleven disposal plants."

SCOPE OF INVESTIGATIONS

A general outline shows the type of correlative and specific investigations in progress and planned for the near future by the experiment station.

Chemical

1. Determinations of relative and definite amounts of the intermediate and end products of biological activity in Imhoff tanks and sprinkling filter, i.e., organic acids, amino acids, indol, skatol, NH_3, N_2, CO_2, CH_4, H_2, CO and the resultant compounds (carbonates, sulfates, H_2S) and their variations under different conditions as an index to changes in the aggregations and metabolism of the organisms which produce those products.
2. Digestion changes in fresh solids, scum, and sludge by determinations of moisture, volatile matter, ash, total nitrogen, ether-soluble and crude fiber.
3. Study of the fate of paper in the Imhoff tanks.
4. Nitrogen transformation studies in the filter beds.
5. Sulfur transformation studies throughout the plant.
6. Study of pH changes throughout the plant, comparison of individual tanks, units and different layers in filter bed.
7. Fertilizer value of sludge as determined by chemical determination (amounts of P_2O_5, N in different forms, K_2O, etc.) and pot experiments. Fertilizer value of treated and untreated sludge.

Bacteriological

1. Digestion in Imhoff tank and the sprinkling filter bed.
   a. Proteolysis
   b. Carbohydrate digestion
   c. Fat digestion
2. Relation of oxidation and reduction in sewage disposal as affected by bacteria. Nitrogen and sulfur cycles.
3. Laboratory studies of fresh solids digestion. Production of:
   a. organic acids (amino acids included)
   b. indol, skatol
   c. gases

4. Environmental factors and bacterial growth. Effects of:
   a. oxygen tension
   b. hydrogen-ion concentration
   c. surface tension
   d. viscosity
   e. inorganic constituents
   f. temperature
   g. associated plants and animals
5. Studies on organisms isolated.
6. Studies on filter flies as bacterial carriers.

Zoological

1. Studies on life history, nutrition and excretion of *Opercularia*, the dominant organism in the filter bed.
2. Inquiry into the nature of the food of the protozoa in Imhoff tanks to determine whether they absorb organic food from solution, or live largely on bacteria and solid particles.
3. Study on the physiological activities of Nematodes.
4. Studies on the recovery of nitrates and ammonia nitrogen by protozoa (Fixing of atmospheric nitrogen included).
5. Determination of part played by protozoa in increase of fertilizing value of sludge.
6. Study of taxonomic and cytological problems.
7. Influence of environmental factors on protozoa.
8. Census of organisms in Imhoff tanks and different layers of sprinkling bed.
9. Studies of methods increasing or decreasing specific groups of protozoa, if increase or decrease of forms seems desirable.

Botanical

1. Census of fungi and algae in sprinkling bed.
2. Classification of the organisms occurring.
3. Study of physiological activities of most prominent forms. (Nutrition, secretion, etc).
4. Influence of environmental factors (temperature, mechanical removal, etc).

Correlative Studies

1. Gross relation between bacterial, zoological, botanical and chemical studies.
2. Correlation between different phases of the problems as they develop.
3. Studies on the activity changes of organisms by mechanical means (influence of stirring, aeration, tank design, etc.)

Cooperative Studies

1. Determination of pH values in Imhoff tanks and filter beds in different parts of the United States, including differences in wastes treated and climatic conditions.
2. Correlation of data obtained with chemical, bacterial, zoological and botanical studies.

The 1924 report contains about ninety pages describing the investigations made during the previous year. These are grouped under the heads: "Chemical Studies on Operating and Resting Imhoff Tanks"; "Bacteriological Investigations on Operating and Resting Imhoff Tanks"; "Studies of the Fauna of Imhoff Tanks and Sprinkling Beds"; "Digestion of Fresh Solids"; Fungi and Algae of the Sprinkling Filter Bed and Their Distribution"; "Experiments on the Physiology of Fungus No. 2 (Penicillium)"; "Digestion of Fresh Solids and Fresh Solids Contaminated with Partially Digested Material"; and "Film Removal Studies." Space can be given for only the summaries and conclusions of these studies.

CHEMICAL STUDIES ON OPERATING AND RESTING IMHOFF TANKS

During every resting period of a tank, the CO_2 content of the gas falls, while during an operating period the CO_2 contents rise.* If the ammonia curve be compared with the CO_2 curve it can be seen that the high peaks for ammonia correspond with low CO_2 production, except in the cases during and shortly after sludge drawing when the ammonia had not yet had a chance to accumulate. In comparing the CO_2 curve with the carbonate curve it can be seen that something similar took place but that the carbonates reached the higher peaks shortly after the ammonia had risen. One would expect that the total acidity present would more or less coincide with the CO_2 content of the gas. However, this is not true, and suggests that total acidity is only partly influenced by CO_2 production. When the pH values are compared directly with the CO_2 content of the gas produced there seems to be a general inverse relation. When pH values are low, CO_2 contents are high. Hydrogen-ion concentration determinations are measurements of the free acid present. It is natural for high CO_2 content of the gas to influence the pH readings. However, since we are dealing with a number of processes taking place simultaneously it can be expected that pH values will not always follow the CO_2 curves. The continuous molecular rearrangements of the protein and carbohydrate material are apt to influence the hydrogen-ion concentration, the continuous formation of organic acids and simpler compounds becomes greater and therefore has more effect on pH changes as digestion progresses. When CO_2 production becomes greater, the influence of the resultant carbonate compounds becomes greater, and with the constant production of ammonia the amounts of free acid change. From all our work thus far it seems clear that the hydrogen-ion concentration gives a true index of the total activities taking place in the tank. If the production of one compound over-balances another it is shown by the pH values. If a possibly desired production of alkaline compounds is suppressed or superceded by acid production the hydrogen-ion concentration is apt to show what is taking place.

Summary

The investigations reported were made for the purpose of acquiring a more exact knowledge of sludge digestion. The nature of tests and sampling is described in detail. Practically all observations and determinations made on the resting and operating tanks point to a rise and then a fall in digestive activity during the course of the tests. Detailed discussions are given on the behavior of the tanks and gas production, CO_2 and CH_4 percentage of the gas, solids, ash, carbonates, total acidity, ammonia nitrogen, influence of temperature and pH values.

High amounts of ammonia corresponded with low percentage of CO_2 production, except in the cases during and shortly after sludge drawing, when the ammonia produced had not yet had a chance to accumulate. Carbonates reached the highest peaks shortly after CO_2 and NH_3-N was high. Total acidity did not coincide with the greatest CO_2 production. A comparison of pH values with CO_2 content shows a general inverse relation. It seems that hydrogen-ion concentration gives a true index of the total activities taking place in the tank. Foaming phenomena occurred when the pH values of the "liquid" between scum and sludge were below 7.0 and foaming subsidies when the hydrogen-ion concentration is above the neutral point.

*See Fig. 1, page 103.

BACTERIOLOGICAL INVESTIGATIONS ON OPERATING AND RESTING IMHOFF TANKS

The work for 1922-23 gave a survey of various bacterial activities throughout the plant. The experiments in 1923-24 have begun the study of the relation of the various bacterial activities in Imhoff tank digestion as it occurs at Plainfield in tanks which are heavily loaded. The experimental data seem to establish the fact that in these tanks there is an inverse relationship between the numbers of albumen-digesting and hydrogen sulfide-producing bacteria. This suggests that different types of digestion dominate at different times. Our next task is, then, the discovery of the relation of other bacterial groups and from that we shall be led to an analysis of the causes which produce these relationships. The regulation of the related factors which govern sewage disposal, whether bacteriological in the narrow sense of this paper or biological in the fuller sense of the work of the staff, is the conscious or unconscious aim of every sewage plant operator.

FAUNA OF IMHOFF TANKS AND SPRINKLING BEDS

So far the studies on the protozoa of the Imhoff tanks have led to some conclusions which are still speculative. It is probable that these organisms afford a fair criterion as to the proper working conditions in the tanks, for when the tanks foam or seem to digest poorly, the number of protozoa is high; when there is but little solid matter in the liquid the number tends to be small.

It is questionable if their numbers are ever large enough to affect the bacteria in the tanks. The reverse is more apt to be true.

They may add some nitrogen to the sludge, in the aggregate, either from their own bodies or by nitrification. This last problem is under investigation at present.

DIGESTION OF FRESH SOLIDS

When the general shapes of the curves for pH values, carbon dioxide, "total" bacteria and "total" animals are compared it is at once evident that a relation exists. Bacteria which produce carbon dioxide influence the changes of the pH index. A fluctuation in bacteria seems to be correlated with a fluctuation of animals. With the rise and fall of the carbon dioxide a rise and fall of hydrogen-ion concentration occurs. Keeping in mind the fact that the chemical analyses were made from a portion of the same material but digested in a separate bottle these two curves seem to be analogous. It seems that when fresh solids are unseeded and confined in a closed container the first acid products are inimical to further rapid digestion, which does not take place until these acid products have been broken down. The general relation between the different curves seems to indicate that the course of digestion is in a definite direction. The fluctuations in the curves and especially in the curve for total bacteria, however, seem to emphasize the fact that "digestion" is not a single simple breaking down of material. The total make up of sewage is such that a number of the substances present are decomposed not only into different stages, but also at different rates. It is very likely that protein material is decomposed at a different rate from carbohydrates. In this respect it will be of great interest to determine qualitatively and quantitatively the organic acids formed in the course of digestion of fresh solids, and also the amount of indol and skatol formed, particularly during the first part of the digestion period. The general curves noted in the different graphs for fresh solids digestion can also be plotted from fresh solids which have been mixed with other solids. Moreover the shape of the curves constructed from gas analyses data obtained from scum left in the tank but confined in a 5-gallon bottle is essentially the same. The studies conducted on tank 3 and the digestion of fresh solids have led us to make an effort to compare the results obtained and correlate the phenomena observed. In figure 2 an example of a direct comparison is given between bacteria and protozoa of the liquid and the percentage of carbon dioxide in the gas from tank 3. This figure seems to show that there is an apparent relation between bacteria in the liquid and the CO_2 content of the gas. There is also a correlation between protozoa and bacteria, but the protozoa increase usually shortly after the bacteria reach a high peak. It has been pointed out before, that high amounts of ammonia occur when the tank is closed and during the time when the protozoa decrease. It is seen, therefore, that the accumulation of ammonia in the tank might be due in part to the dying of microscopic animals.

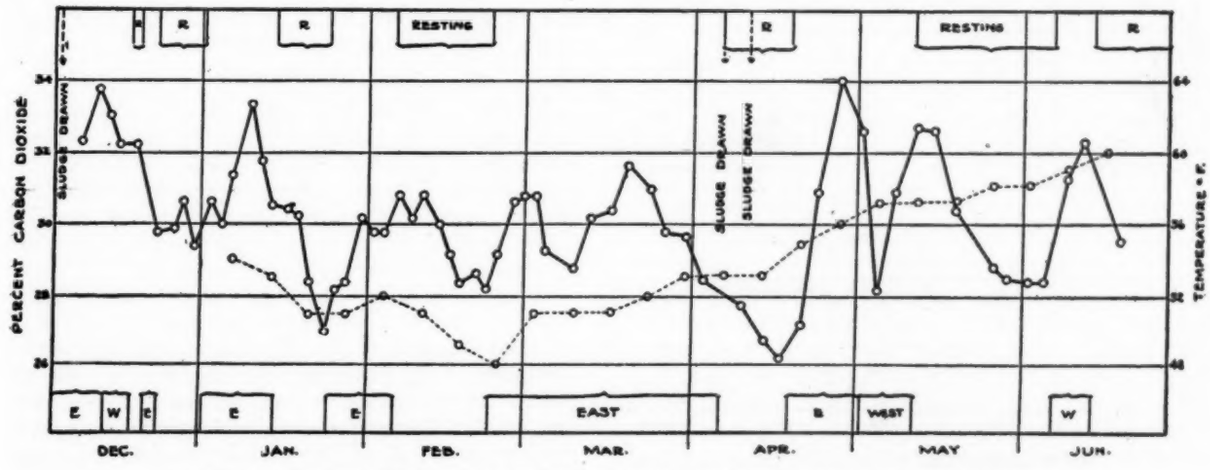


FIG. 1.—FLUCTUATIONS IN CARBON DIOXIDE CONTENT OF GAS FROM TANK.

The relation between chemical end products other than CO_2 and bacteria is not directly apparent from the studies in the tank. This is not strange, since total bacteria include the different groups. At present no comparison of single groups of bacteria and the chemical analyses can be made because sampling periods were not sufficiently close together and the different factors influencing bacterial activities not well enough known. A detailed and intensive study is planned to bring out the relations more sharply. However, we have evidence favoring the supposition that a succession of bacterial groups exists which is influenced by the chemical products both intermediate and final. In this relation we might consider every fall and rise in the curves constructed for the resting and operating tank studied in detail during the months of December to April as parts of the curves obtained for fresh solids digestion, where the low part of the curve coincides with the end of the resting period. In other words, the conditions in this overloaded tank were very similar to those in the bottle of fresh solids in the laboratory. This can be explained by the fact that the masses of fresh solids coming in could not be taken care of rapidly enough without causing foaming phenomena, and the tank had to be closed or "rested." Leaving aside the possible reasons why this tank was unable to cope with incoming solids, it appears that these solids followed a course similar to those studied in the laboratory.

Fresh solids seem to digest in the same manner when contaminated with partially digested material. Material in the digestion chamber of an Imhoff tank, whether operating or resting, appears to follow a similar course. It is therefore reasonable to assume that the digestion processes in the Imhoff tanks follow one general trend. Since fresh material is constantly added, the different solid particles in the tank are necessarily at different stages in the process of decomposition. Theoretically it would be possible to construct individual curves for each particle present in the tank which would show the actual stage of its decomposition. When these individual curves were plotted on a time basis (time showing the entrance of the particle in the tank and the length of decomposition), they would naturally overlap each other. If the moving averages of the different points in the individual curves were taken from these overlapping curves, general curves for each point could be constructed. This moving average would show slightly lower values than the values obtained for the incoming material. If a total average were taken the values obtained would be still lower. Therefore a value determined during any given sampling period is the resultant of particles present in different stages of decomposition.

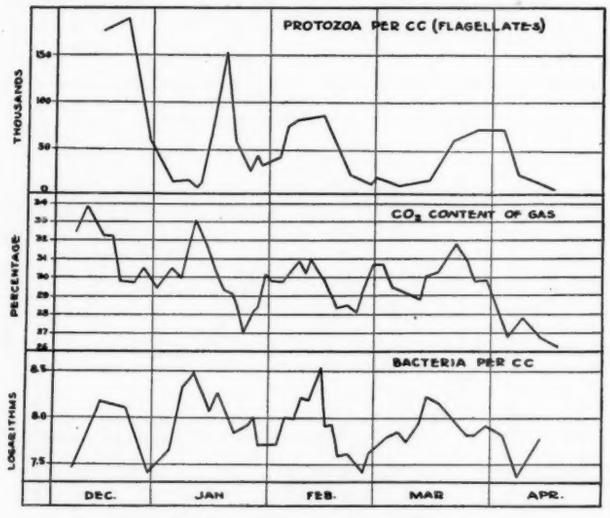


FIG. 2.—COMPARISON BETWEEN BACTERIA AND PROTOZOA OF LIQUID AND CO_2 OF THE GAS.

We know from our experiments of unseeded fresh solids and contaminated fresh solids that decomposing fresh material turns acid and has a tendency to remain acid for some time until the decomposition has progressed far enough to produce alkaline products. The simultaneous production of acid and akaline products in a tank makes the construction of simple curves more difficult, but the determination of free acid as measured by the hydrogen-ion concentration method will show whether digestion is in an acid or in an alkaline direction. In this connection it is extremely interesting to note that the apparent "danger line" for the Plainfield tanks is around pH 7.0 or the neutral point. When the liquid registers a pH below 7.0 we know that the solids will rise and foaming result, and as soon as the hydrogen-ion concentration is slightly above the neutral point foaming subsides and the scum recedes. It is of practical value to know whether the acid or alkaline tendency in the tanks becomes the more pronounced.

In connection with the cooperative studies we are engaged in a thorough survey in order to establish the relation existing between bacteria and animal groups and the products of their activities (NH_3, CO_2, CH_4, N_2, CO_3, total acidity, etc.) and pH values as a means of registering total activities. With the accumulation of data it is intended to give the cooperators the benefit of the investigations and publish the information obtained as soon as definite conclusions can be drawn.

Simultaneously with this work a comparison is being made of a thoroughly "sick" tank and one which has been altered and was put into operation on April 21. We are also obtaining data on a tank which is being used as a storage tank.

The experiments thus far show that the Imhoff unit influent is always slightly alkaline and the effluent slightly less so or neutral, while the effluent of the "sick" tank is usually below neutral.

Summary

An effort was made to study digestion phenomena in a quantity of unseeded fresh solids. The fresh solids were placed in the laboratory at 20°C. and analyzed at frequent intervals for ammonia, carbonates, total acidity and carbon dioxide, and the bacterial numbers, protozoa, total gas production and hydrogen-ion concentration determined.

A relation seems to exist between the "total" bacteria, "total" animals, percentage of carbon dioxide of the gas and the pH values obtained. Bacteria producing CO_2 influence the changes of the pH index. A fluctuation in bacteria seems to be correlated with a fluctuation of microscopic animals. With the rise and fall of the carbon dioxide a rise and fall of hydrogen-ion concentration occurs. The rela-

tion between chemical end products other than CO_2 and bacteria was not directly apparent. Fresh solids seem to behave very similarly whether mixed with partially digested material or collected directly. Material digesting in an operating or resting tank seems to follow in general the same course of digestion as fresh unseeded or contaminated solids, but curves constructed for the tank material will show overlapping points.

Decomposing fresh material turns acid and has a tendency to remain acid for some time until the decomposition has progressed far enough to produce alkaline products. When the "liquid" in the Plainfield tanks registers a pH below 7.0 (neutral point) solids will rise and foaming results, when the hydrogen-ion concentration is slightly above the neutral point foaming subsides and the scum recedes.

FUNGI AND ALGAE OF THE SPRINKLING FILTER BED AND THEIR DISTRIBUTION

Fungi are never abundant on the surface stones but are usually present in small amounts. The various fungi and filamentous bacteria found below the surface of the filter bed fluctuated considerably. This year's work shows that the fungi were distributed fairly uniformly throughout the bed with a possible tendency of greater abundance towards the surface of the bed. This was noticed especially when the total amounts of fungi started to decrease. The most abundant organism was fungus No. 1, a penicillium. After fungus No. 1 had reached a high peak fungus No. 5 (dictyuchus) increased rapidly. Upon the disappearance of this penicillium fungus No. 4 (pythium) made its appearance and overbalanced any other single organism.

Algae were again found in extremely small quantities at the different levels of the bed. It is possible that these algae were washed down with the sewage sprayed intermittently on the surface of the bed.

It seems significant that during the summer months the fungi are very scarce, sometimes disappearing entirely. It is possible that the increased temperature has a direct influence upon the disappearance of the fungi; it is also possible that the increased efficiency in nitrification of the bed during this time is a factor, especially in view of the fact that inorganic nitrates are not available for the penicillium experimented with in the laboratory.

Considerably more work has to be done on the seasonal distribution and physiology of the organisms concerned before definite conclusions can be reached on the relative importance of the fungi as binders in holding the film together around the stones, their part played in film removal (slough), and last but not least their importance in the stabilization and purification of the sewage as it passes the bed. The question of their relation to the activities of bacteria and microscopic animals in the film is closely connected with their physiology and relative abundance.

Summary

Examinations of the film on the stones of the filter bed were continued during this year for the determination of relative abundance and fluctuation of fungi, algae and filamentous bacteria. There was a seasonal fluctuation of fungi, reaching a maximum during the winter months.

The relation between the temperature of the sewage as it reaches and leaves the bed and the total fungi is indicated.

EXPERIMENTS ON THE PHYSIOLOGY OF FUNGUS NO. 2 (PENICILLIUM)

Fungus No. 2 (Penicillium) was isolated and grown for experimental purposes. A number of inorganic and organic compounds were tried for their availability of nitrogen. It was found that inorganic nitrogen was not available, while the nitrogen from bacto-beef extract was most available. The organism was unable to live and reproduce in the absence of air. Aeration seemed to favor growth. Preliminary experiments indicated that the fungus did not produce ammonia. The organism was unable to decompose cellulose or liquefy gelatin.

DIGESTION OF FRESH SOLIDS AND FRESH SOLIDS CONTAMINATED WITH PARTIALLY DIGESTED MATERIAL.

Samples of these two classes of solids were kept for several months at 20°C in an incubator. The uncontaminated solids took 52 days to reach the original pH of 6.4; 66 days to reach a pH of 6.8; and 119 days to reach the neutral point. The contaminated solids reached these points in 25 days, 28 days and 37 days respectively.

FILM REMOVAL STUDIES

The results of these studies were described at length by William Rudolfs, chief of the sewage investigations, in an article in PUBLIC WORKS for November, 1924.

Thickened Edge Pavements

The concrete pavement cross-section with thickened edges, although frequently called the Illinois Section, is believed to have been first used in Maricopa County, Ariz., several years before it was adopted by the state of Illinois, and the real value of the type was demonstrated by the Pittsburg, California, road tests as well as those of the Bates Road in Illinois. At least thirty-one states have now adopted a cross-section for concrete pavements with edges thicker than the middle. However, the details of the thickening vary somewhat. In California the thickness increases from 6 inches to 9 inches in 2½ feet. In Pennsylvania the thickness is increased 3 inches in 4 feet. In New York there is a gradual increase in thickness all the way from the center. In North Carolina, also, there is a gradual increase, both the subgrade and the pavement surface conforming to definite curves.

Motor Bus Transportation

The secretary of the National Motor Truck Committee of the National Automobile Chamber of Commerce states that 12,500 buses and vehicles for bus use were placed in service during 1924, and estimates that 2,500 million passengers were carried in old and new buses during 1924. This, he claims, indicates that the bus is fast assuming a major position in our transportation system.

Recent Legal Decisions

MUNICIPALITY HELD NOT LIABLE FOR NEGLIGENCE OF ITS EMPLOYEES EMPLOYED IN GOVERNMENT FUNCTION

The Ohio Supreme Court holds, City of Akron v. Butler, 140 N. E. 324, that a verdict for the municipality should be directed in an action for personal injuries caused by the negligence of its employee, as in driving a truck, where the plaintiff fails to prove that the employee was at the time engaged in performing a proprietory, as distinguished from a governmental, function of the municipality.

NO LIABILITY IMPOSED ON WATERWORKS COMPANY FOR FIRE CAUSED BY INSUFFICIENT SUPPLY UNDER PUBLIC UTILITIES ACT

The Indiana Supreme Court holds, Trustees of J. de Pauw, etc., Church v. New Albany Waterworks, 140 N. E. 540, that neither section 7 nor section 116 of the Indiana Public Service Commission Act imposes liability on a waterworks company for damages for fire caused by an insufficient water supply.

PARK STATUES DONATED MAY BE MOVED FROM ONE POINT TO ANOTHER

The New Jersey Court of Chancery holds, Coles v. City of Newark, 121 Atl. 782, that the absolute and unconditional gift of a statue to a city for use in a park vests title in the city, which holds the statue, however, in trust for public use. The selection of a site for it by the donor and the city before the gift is made does not imply a condition of irremovability; and, although the city could not arbitrarily demolish or dispose of it, it cannot be enjoined by the donor from removing it to another point in the park, not remote or obscure.

ZONING ORDINANCE PROHIBITION OF STORE BUILDING HELD INVALID

The New Jersey Supreme Court holds, Ignaciunas v. Risley, 121 Atl. 783, that a zoning ordinance prohibiting the erection of a store building in a specified district by an owner of property therein is void as an unconstitutional violation of the rights of private property and not a valid exercise of police power in the interest of public health, safety and welfare.

RELAXATION OF ZONING ORDINANCE REQUIREMENTS BY MUNICIPALITIES

The New Jersey Supreme Court holds, Allen v. City of Paterson, 121 Atl. 610, that the power given a city's board of zoning appeals by statute and zoning ordinance to vary any requirement of such ordinance to avoid injustice to property owners may be exercised by resolution and cannot be controlled by the courts, in the absence of unreasonableness, fraud or bad faith.

PARKING ORDINANCE HELD VALID AS REGULATION OF TRAFFIC

The New Jersey Supreme Court holds, Welsh v. Town of Morristown, 121 Atl. 697, that an ordinance enacting that no automobile or other vehicle shall be parked or allowed to stand for a longer time than is necessary to take on and let off passengers or baggage, and in no case longer than two minutes, in a designated public place, is, under present-day conditions, a "regulation of traffic."

WHETHER SAND CLAY ROADS MAY BE CLASSED AS HARD-SURFACED HELD MATTER OF FACT

The Florida Supreme Court holds, McDonald v. Fraleigh, 98 So. 830, that public roads or highways which may be classified under Florida Rev. Gen. Stat., Sec. 1531, as "paved, macadamized, or other hard-surfaced highways" may be constructed of a proper combination of sand and clay suitable for the purpose. But whether a highway so fabricated or surfaced is "paved, macadamized or hard-surfaced" within the meaning of the statute is a practical question dependent upon a number of elements, such as suitableness of material employed, formula used in the combination, and the like.

DUTY OF CITY AND EXCAVATING CONTRACTOR AS TO LATERAL SUPPORT

The Connecticut Supreme Court of Errors holds, Canfield Rubber Co. v. Leary & Co., 121 Atl. 283, that because an excavating contractor, acting under the authority of the city, has the right to withdraw lateral support from an adjoining owner's building, provided it does not cause that owner's soil to settle of its own weight, it does not follow that it has the right to do so without taking reasonable care to avoid inflicting unnecessary harm. If the injury to the adjoining owner's building is unavoidable, the city and its contractor may, it is held, after notice, proceed with the work and injure the building without liability. But if the injury is avoidable by the excercise of reasonable care, they must exercise their undoubted right to construct a sewer in the highway on the same terms, as against the lawful rights of others, as they, and all responsible persons, are required to exercise all other rights. The action was one by the owner of a building against a contractor for negligence in excavating a sewer ditch in front of plaintiff's building whereby the lateral support of the plaintiff's soil was removed and the building damaged.

CONSTRUCTION OF SEWER SYSTEM "DEEMED ADVISABLE" BY ORDER FOR PREPARATION OF FINAL PLANS

A city employed engineers to plan a sewer system, their compensation, under the contract to be a percentage of the cost of the work, payable "upon presentation of the final detail plans and specifications for such portion of the work which the city council shall deem advisable to construct." The preliminary plans and reports were approved by the council and the engineers were directed to prepare complete plans of certain sewers, which they did. In an action for their services, the Missouri Court of Appeals, held, Benham v. City of Marceline, 251 S. W. 748, that they were entitled to the compensation agreed upon, although the city subsequently de-

cided not to build any of the sewers, since the city by directing the preparation of the final plans "deemed advisable" the construction of the portion of the sewer system embraced in these plans.

RIGHT OF DISTRICT, UNDER ROAD CONTRACT, TO SUSPEND WORK—AMOUNT OF RECOVERY BY CONTRACTOR

In an action on a road construction contract where the district, at a meeting at which the contractors were present, decided to suspend the work, the Arkansas Supreme Court held, Perdue & Hill v. Road Improvement Dist. No. 1, 251 S. W. 886, that the contractors should have then stated that they would treat the suspension of the work as a breach of the contract, if they did not agree to it. A clause in the contract provided that the board of engineers might suspend the work because of unsuitable weather or other unfavorable conditions or failure of the contractors to carry out orders. It was held that while this clause did not authorize the district to act arbitrarily or in bad faith, if their action in suspending the contract was not arbitrary or in bad faith, the suspension was not a breach of the contract, if the district, in good faith, concluded that the conditions were too unfavorable to continue the work. The suspension of the work being held valid and not a breach of the contract, the contractor was held not entitled to anticipatory profits where he refused to resume work when requested. But under a provision that, if the district should complete the work on the contractor's failure to do so, the contractor, if the completion should cost less than the contract price, should recover the difference, the contractor was allowed such difference in the cost of construction.

It was held that under the express terms of the contract 2,800 pounds of gravel constituted a yard.

BRIDGE CONSTRUCTION WARRANTS HELD VALID THOUGH ORDER OF ALLOWANCE IRREGULAR

After the construction of a bridge for a county, it was paid for out of a road improvement district's funds and warrants were afterwards issued to the construction company, which assigned them to the road improvement district. The Arkansas Supreme Court holds, Woodruff County v. Road Improvement Dist. No. 14, 252 S. W. 930, that the order of allowance was not void, but merely irregular.

MEASURE OF DAMAGES FOR POLLUTION BY SEWERAGE SYSTEM

The Texas Court of Civil Appeals holds, City of Graham v. Moseley, 254 S. W. 130, that in cases of a temporary and removable nuisance by the pollution of water by a sewerage system, the measure of damages is that which has been inflicted within two years preceding the trial, and not the depreciation in the value of the premises at the time of the construction of the work which occasioned the nuisance.

IN LETTING PUBLIC CONTRACTS EXPRESS PROVISIONS OF STATUTE MUST BE FOLLOWED

The Missouri Supreme Court holds, Hillsides Securities Co. v. Minter, 254 S. W. 188, that, in letting contracts for the construction of bridges, public buildings, etc., the county court or other public authority must follow the express provisions of the statute, or such contracts will be void, and the county, city, or school district, as the case may be, will not be bound to pay for the work done under such contracts. Persons contracting with county courts must be held to know the law and to know that contracts not entered into in compliance with such statutory provisions are void. To permit recovery under such contract for the reasonable value of the work done thereunder by denying injunction sought by a taxpaying citizen would be, it is held, to permit the county to do indirectly that which it is forbidden to do directly, and would furnish a ready means of evading the law.

PERMISSION TO ONE PERSON TO COLLECT GARBAGE NOT A MONOPOLY

The Oklahoma Supreme Court, Burns v. City of Enid, 217 Pac. 1038, holds, that a city, in the excercise of its police power, may, by reasonable ordinance, regulate the collection and disposal of substances which are of such a condition and character as to be nuisances per se, and deleterious to the public health or comfort, or liable to become nuisances unless immediate care is taken; and it does not create an unlawful monopoly, or unlawfully restrain trade, to permit the business of collecting and disposing of such substances to one person, and to exclude all others from such business.

DELAY OF FOUR YEARS IN ISSUANCE HELD NOT TO INVALIDATE FILTRATION PLANT BONDS WHERE NECESSITY THEREFOR CONTINUES

The Kentucy Court of Appeals holds, Wall v. City of Elizabethtown, 254 S. W. 893, that a delay of four years in issuing bonds for the construction of a filtration plant was not so unreasonable as to affect the validity of the bonds, where the necessity for improving the waterworks system continued to exist, and the delay was due to the city's desire to make an improvement at lower prices than those prevailing, as well as its inability to market the bonds to advantage.

LOCATION OF FEDERAL HIGHWAY THROUGH MUNICIPALITIES

The Kentucky Court of Appeals holds, Bickett v. Meade County, 252 S. W., 1017, that an agreement for a right of way for a federal highway through two villages, an unincorporated community grouped around a crossroads, and a farm, is sufficiently complied with by locating the highway through the community within half a mile of the crossroads.

COUNTY HELD NOT LIABLE FOR INJURY FROM COLLAPSE OF BRIDGE

The Tennessee Supreme Court holds, Corothers v. Shelby County, 253 S. W. 708, that, under the general rule that a county, in excercising a prerogative of sovereignty delegated by the state, cannot be sued for injury caused by negligent construction and maintenance of public highways and bridges, it is not liable for injury resulting from the collapse of a county bridge.

DAMAGES FROM INSTALLATION OF DEFECTIVE DRAIN PIPE HELD BARRED BY LAPSE OF TIME

In an action against a city it was alleged that the down and drainage pipe installed by the city in front of plaintiff's premises was too small to carry off the water, and that the sewer was allowed to clog and fill with debris, causing the water to stand over her premises. The Kentucky Court of Appeals held, Town of Williamstown v. Carnes, 255 S. W. 1048, that as the improvement was made more than 20 years before the commencement of the action, plaintiff's right to recover for the wrongful act of the city in constructing and installing a drainage pipe—a permanent structure—too small to carry off the water was barred long before the action was commenced. If, however, the city negligently permitted its drain pipes to be clogged up and thereby cast water upon plaintiff's premises to her damage within five years next before the commencement of the action, it would be liable for the damage caused thereby, and that question alone should have been submitted to the jury.

PROVISION THAT CONTRACTOR PURCHASE REVENUE BONDS AT PAR HELD VALID

The Colorado Supreme Court holds, Shields v. City of Loveland, 218 Pac. 913, that revenue bonds payable wholly out of the revenue of an electric light plant do not constitute a debt within the meaning of the Constitution or statutes limiting the indebtedness of municipalities.

It also held that an ordinance requiring a contractor to purchase revenue bonds at par is valid. The court said: "If a bidder is able to take the bonds for cash at par it is strong evidence that he is solvent and responsible and will fulfill his contract. The council has a right to prescribe reasonable qualification for bidders, e. g., they usually require the deposit of a certified check to insure good faith and responsibility. They are not obliged to accept bids from every newcomer who offers to do the work for the lowest price."

STATUTORY BOND ESSENTIAL TO VALIDITY OF ROAD CONSTRUCTION CONTRACT, BUT CONTRACTOR CAN RECOVER ON QUANTUM MERUIT IN ABSENCE OF BOND

The Arkansas Supreme Court holds, Burt v. Road Improvement Dist. No. 11, 253 S. W.1, that the giving of the statutory bond is a condition precedent and essential to the validity of a contract for the building of roads under the Arkansas road improvement district law, although the statute does not specify whether the bond shall be made before or after the contract is actually signed; and a road construction contract was held ultra vires and void because no bond was executed in compliance with the statute, and the contractor could recover nothing under the contract.

But it was held that the contractor could recover on a quantum meruit, and the district could not recover back the amount paid him because of failure to execute the bond. While the contract was ineffectual, the work which the contractor did and the district permitted did not involve any fraud against the district. The language of the statute does not expressly prohibit the making of such a contract and does not expressly make it unlawful to enter into such a contract. Therefore it does not come within the general rule that where a contract is immoral or expressly prohibited, or is malam prohibitum, no court of justice will entertain an action upon it or upon any asserted rights growing out of it. The measure of the contractor's recovery, however, would be the value of the work done by him at the time the district received the benefit thereof, and not at the time the work was done.

A subcontractor who performed part of the work under the supervision of the district engineer, who testified that the work was satisfactory and the sum claimed therefor correct was held entitled to recover on a quantum meruit, with interest.

DISCHARGE INTO RIVER OF SEWAGE PROPERLY TREATED HELD NOT A NUISANCE

In an action to abate an alleged nuisance consisting of the discharge by a city of sewage effluent into a river, expert witnesses went into the subject of sewage disposal at considerable length, and explained the various processes by which obnoxious substances are rendered harmless, and also the various methods of disposing of such substances. These witnesses agreed that sewage farms were not advisable in this case, and that there was no reasonable probability of a communication of disease by the present method when it was treated as it was being treated or processed at the time of the trial. This testimony was held sufficient to sustain a finding that the city was not maintaining a nuisance.—People v. City of Reedley. (Cal. App.) 226 Pac. 408.

"BRIDGE" IN STATUTE MAY OR MAY NOT INCLUDE APPROACHES

The Connecticut Supreme Court of Errors holds, City of Stamford v. Town of Stamford, 124 Atl. 26, that a bridge is a part of the highway over a river, stream or railroad, and the roadway over it is a part of the bridge. The word "bridge" when used in a statute, may or may not include its approaches, according to the context and the circumstances of each case. As used in section 174 of the revision of the charter of the city of Stamford it was held that its context showed that it was not intended to include the approaches to the bridge, and that it was the duty of the town of Stamford to repair the roadways of the bridges over railroads within the territorial limits of the city.

NO RECOVERY ALLOWED FOR NEGLIGENCE OF EMPLOYEE OF STREET CLEANING DEPARTMENT

The Pennsylvania Supreme Court holds, Scibilia v. City of Philadelphia, 124 Atl. 273, in an action for injuries caused by an automobile truck operated by an employee of the city's street cleaning department, that the removal of ashes or refuse by a municipality is a governmental function, designed primarily to promote the public health and comfort, and no recovery can be had for negligence in its performance; and that the fact that a statute authorized the city to clean the streets by letting contracts for the work did not show that the Legislature did not consider such service as purely governmenal, such letting not being technically a delegation of the function.